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AN ANNOTATED LITERATURE SURVEY OF SUBMARINES, TORPEDOES, ANTI-SUBMARINE WARFARE, UNDERSEA WEAPON SYSTEMS, AND OCEANOGRAPHY: 1941 TO JANUARY 1962

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A B S T R A C T

This literature survey of 485 references includes the fields of Submarines (with a descriptive breakdown of subjects), Anti-Submarine Warfare (ASW), Undersea Weapons Systems (UWS), Torpedoes, and Oceanography. The latter pertains primarily to oceanographic instrumentation for measuring depth or motion of waves or characteristics of the ocean. Most of the literature references are between the years 1952 and 1962, although the entire scope ranges from 1941 to 1963. News items have also been included where there was belief of value. The references within each category are alphabetized by source, author, date and page number. Following the references are 3 complete indexes: author, source and corporate author and subject.

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INTRODUCTION

The present literature survey on submarines is inclusive of many other vitally related fields -- vital to the defense of our country. This bibliography makes no pretense of being inclusive of the entire literature in all of these fields, but ranges in scope from 1941 to January 1962. Little of the material relates however to the 1940's.

It is believed by those who are in a position to know the facts that the nation that rules the seas will be able to win any war. The U.S.S.R. has recognized the importance of this fact; their Arctic research stations exceed the United States by ten times, and their research ships exceed twice those of the United States. Their submarine fleet, but not their Navy in general, is statistically superior to that of the United States. American oceanographers are endeavoring to make known our needs, and the science of oceanography is rapidly approaching a state of activity comparable with modern industry. This bibliography combines oceanography, submarines, torpedoes, and ASW as they cannot be divorced in this age of the "cold war," always prevailing upon us.

This report has, therefore, been divided accordingly by the following subjects; as designated by our requestor, Mr. Richard Olshausen, Preliminary Engineering Section, Advanced Controls Systems Group, Armament

and Flight Control Division, Anaheim, California:

A. SUBMARINES

1. Control Systems
2. Study of Submarine Noise
3. Model Tests and Sea Trials
4. Analytical Studies of Stability and Control Investigations
5. General Articles on Submarines

   a. Marketing
   b. History and Bibliographies
   c. Fleet Rehabilitation and Modernization
   d. Foreign Progress and Past Events
   e. Optical and Other Equipment in/for Submarines
   f. Nuclear Submarines

B. TORPEDOES

C. ASW (Anti-Submarine Warfare) and UWS (Undersea Weapons Systems)

D. OCEANOGRAPHY, the primary purpose of which is to learn of oceanographic instrumentation for measuring depth or motion of waves or characteristics of the ocean.

It is this author's belief that these categorization breakdowns, combined with a phraseology breakdown within the subject index, are self-explanatory of content. The references within each category are alphabetized by source, author, date, and page numbers respectively. News items have been included for the information which we believe will be valuable in providing knowledge of new developments, contracts awarded or to be awarded, and companies working on projects. Additional information may be obtained through correspondence with these companies. Following the references are three complete indexes: author, source and corporate author, and subject. There are 485 references in the main body of the bibliography. Following the main body is an addendum of 48 uncategorized, unindexed references. This last section, unearthed between compilation and finalization, has been considered of sufficient usefulness for inclusion.

SECTION A

Submarines

SECTION A

Submarines

1. Control Systems

1. SUBMARINE COMPUTERS. C. F. Abt. (Arma Engineering, Vol. 3, No. 1, December 1959–January 1960, pp. 27-31)

Relative merits of digital vs analog computers in submarine control equipment; with miniaturization rapidly progressing, single central digital computer in submarine, controlling all operations such as ship control, detection devices, and fire control, is held to be optimum solution.

2. ANIP. SUBIC. SURIC. (Symposium Proceedings, Sponsored by U. S. Army Signal Corps, Statler-Hilton Hotel, Dallas, Texas, 31 August-2 September 1959, Progress Report, 1 November 1959, 454 p., CONFIDENTIAL) AD-315 579

3. AUTOMATIC DEPTH CONTROL OF SUBMARINES. A. Garde and E. Persson. (ASEA Journal, Vol. 33, No. 4-5, 1960, pp. 65-70)

Design of system is based on experimental frequency-response curves, characterizing effect of control hydroplanes on hull of submarine; operational experience.

4. PROPOSED SUBMARINE SHIP CONTROL COMPUTER REQUIREMENTS STUDY FOR ELECTRIC BOAT. (Autonetics, a division of North American Aviation, Inc., Report No. EM-5575, 28 October 1958, CONFIDENTIAL)

Contents include: Electric Boat Company; Submarine systems; Computers, submarine.

5. FLIGHT CONTROL CAPABILITIES - STEERING AND DIVING SYSTEM FOR SUBMARINE AGSS - 555. (Autonetics, a division of North American Aviation, Inc., Downey, California, (Armament and Flight Control product line), Report No. EM-7252, 5 September 1961, UNCLASSIFIED)

Contents include: Autonetics - Capabilities; Submarines - Diving; Submarines - Control Systems; Flight Control Systems; AGSS-555 (Model)

6. STEERING AND DIVING SYSTEMS FOR SUBMARINE AGSS-555 - Technical Proposal. (Autonetics, a division of North American Aviation, Inc., Downey, California, (Armament and Flight Control product line), Report No. EM-7253, 5 September 1961, UNCLASSIFIED)

Contents include: AGSS-555 (Model); Submarines - Diving; Submarines - Control Systems.

7. STARDAC. A HYBIRD COMPUTER KEEPS SUB ON TARGET. G. D. Boinhocker and T. J. Fitzgerald. (Control Engineering, Vol. 8, June 1961, pp. 101-105)

8. THE RESPONSE OF A SSGN (FBM) SUBMARINE TO SUBMERGED LAUNCHING OF SIXTEEN POLARIS MISSILES BASED ON ANALOG COMPUTER STUDIES. (CONFIDENTIAL TITLE). J. W. Church and C. O. Swanson. (David Taylor Model Basin, Report No. C-910, January 1958, 29 p., CONFIDENTIAL) AD-303 044L

Submit request via Chief, Bureau of Ships, Navy Department, Washington 25, D. C.

9. THE DESIGN OF CONTROL SURFACES FOR HYDRODYNAMIC APPLICATIONS. L. F. Fehlner. (David Taylor Model Basin, Report No. C-358, January 1951, CONFIDENTIAL) AD-133 155

10. POLARIS CREWS GET CONTROL SIMULATOR: NAVIGATIONAL TRAINER. (Electronics, Vol. 34, 9 June 1961, pp. 30-31)

11. NAVY PLANS 12-MAN KILLER SUB: SUBMARINE INTEGRATED CONTROL PROGRAM. (Electronics, Vol. 33, 29 January 1960, pp. 28-29)

12. TACTICAL CONTROL I ANALYSIS OF INFORMATION REQUIREMENTS. Francis J. Wuest and John M. Newton. (Electric Boat, Report No. TR-411-HF-17, November 1958, CONFIDENTIAL)

Contents include: SUBIC (Model); Tactical control systems; ASW (Model); Displays, tactical; Submarines -- Testing; Displays, optical; Submarines -- Control; Submarines -- Research; Submarines -- Evasion characteristics.

13. SHIP CONTROL III DEPTH SEEKING AND DEPTH KEEPING WITH A ONE-SURFACE CONTACT ANALOG DISPLAY. Raymond C. Sidorsky and John M. Newton. (Electric Boat, Report No. TR-411-HF-16, August 1958, UNCLASSIFIED)

Contents include: SUBIC (Model); Displays, optical; Submarines -- Testing; Displays, visual; Displays, tactical; Submarines -- Control; Submarines -- Research; Submarines -- Evasion characteristics; Tactical control systems.

14. SHIP CONTROL IV AN EMPIRICAL EVALUATION OF THE UTILITY OF A PITCH-RATE INDICATOR IN SUBMARINE DEPTH CONTROL. Raymond C. Sidorsky and John M. Newton. (Electric Boat, Report No. TR-411-HF-21, December 1958, UNCLASSIFIED)

Contents include: SUBIC (Model); Displays, optical; Submarines - Testing; Tactical control systems; Displays, tactical; Submarines - Research; Submarines - Control; Submarines - Evasion characteristics.

15. SHIP CONTROL V THE EFFECTS OF MOTION AND NUMBER OF SURFACES ON DEPTH CONTROL WITH A CONTACT ANALOG DISPLAY. Raymond C. Sidorsky and John M. Newton. (Electric Boat, Report No. SPD-59-010, February, 1959, UNCLASSIFIED)

Contents include: SUBIC (Model); Tests, performance; Submarines -- Testing; Tactical Control Systems; Displays, optical; Displays, tactical; Submarines -- Control; Submarines -- Evasion characteristics; Submarines -- Research.

16. SHIP CONTROL VII JUDGMENT OF PITCH WITH VISUAL AND NON-VISUAL CUES. Bret A. Charipper. (Electric Boat, Report No. TR-411-HF-14, 1 July 1958, UNCLASSIFIED)

Contents include: SUBIC (Model); Displays, visual; Displays, optical; Submarines, research; Displays, pictorial; Submarines, Control; Submarines - Evasion characteristics; tactical control systems.

17. SUBIC, SHIP CONTROL I. THE ELECTRIC BOAT SUBMARINE SIMULATOR. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Report No. SPD 59-011)

18. SUBIC SUBMARINE INTEGRATED CONTROL PROGRAM. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-166700, Report No. 411HF-6, Technical Progress Report No. 1, 1 March-30 June 1957, CONFIDENTIAL) AD-309 938

Observation of the BuAer-ONR sponsored Army-Navy Instrument Program indicates that it has already resulted in significant breakthroughs in the field of aircraft control, and further that it promises even greater success in the future, assuming that work in progress and planned is satisfactorily completed. Although submarine control and aircraft control are not equivalent, there are certain similarities in the control requirements for the two. It is therefore pertinent to examine the philosophy and methodology of the ANIP program to determine whether they would be of value in attacking the submarine control problem.

19. SHIP CONTROL II LINEAR AND NONLINEAR QUICKENING. (General Dynamics Corporation, Electric Boat Division, Report No. TR-411-HF-12, 15 June 1958)

20. SUBIC. SUBMARINE INTEGRATED CONTROL. (General Dynamics Corporation, Electric Boat Division, 30 June 1957, 34 p., CONFIDENTIAL)

This brochure outlines a program for the development of a Submarine Integrated Control System aimed at gaining greater effectiveness for submarines.

The nature of submarine control is discussed in the light of the historical development of naval vessels, current advances in aircraft and industrial control procedures, and anticipated submarine performance requirements.

The various submarine control areas are described in some detail, and the scope of the submarine's control problem and the demands on its commanding officer, as expressed in the "command loop" are set forth. A program for meeting these demands is delineated. For its accomplishment an industry-wide organization is proposed, under direction of a "systems manager" responsible to a steering committee composed of representatives of cognizant Navy Bureaus and Offices.

The ultimate objectives of the program are to increase the submarine's combat effectiveness, reduce crew requirements and decrease operational training requirements. One concept leading to these objectives is sketched.

21. SUBIC SUBMARINE INTEGRATED CONTROL PROGRAM TECHNICAL REPORT. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Report No. 411 HF-8, Technical Progress Report No. 2, 1 July-30 September 1957, 23 p., 14 refs., CONFIDENTIAL) AD-309 939

Perhaps the most significant conceptual development during this quarter has been in engineering and casualty control. The section of this report dealing with engineering control describes the extension of the ubiquitous feedback model from depicting man as an element in a continuous control loop to picturing his more frequent function as a monitor.

Engineering and casualty control have been treated together in this report since, with the closed loop model, casualty control is distinguished from monitoring the engineering loop only by the phenomena to be monitored and complexity of the action to be taken. Monitoring the performance of the engineering loop, whether in its normal mode of operation or in one of the emergency modes, implies detection of a malfunction and only limited response alternatives. Casualty control implies the more variable procedures of fault location and repair. There is an extensive literature in the field of fault location which will be applicable to SUBIC.

22. SUBIC STATUS REPORT ON PHASE I. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract NOnr 2512(00), Report No. P58-145(CEB415), 15 August 1958, 165 p., CONFIDENTIAL) AD-303 303

The objective of Phase I of the SUBIC program is to determine the fundamental nature of the submarine's control requirements and to plan and conduct research leading to satisfaction of these requirements. Achievement of this objective constitutes the essential first step in establishing a sound foundation for the long-range program.

23. SHIP CONTROL VI STEERING AND DIVING A SUBMARINE WITH A CONTACT ANALOG DISPLAY. (General Dynamics Corporation, Electric Boat Division, TR-411-HG-20, December 1958)

24. SHIP CONTROL IV AN EMPIRICAL EVALUATION OF THE UTILITY OF A PITCH-RATE INDICATOR IN SUBMARINE DEPTH CONTROL. (General Dynamics Corporation, Electric Boat Division, Report No. TR-411-HF-21, December 1958)

25. SUBIC, SHIP CONTROL VI. STEERING AND DIVING A SUBMARINE WITH A CONTACT ANALOG DISPLAY. (General Dynamics Corp., Electric Boat Division, Groton, Connecticut, TR No. 411 HF-20, December 1958.)

26. TACTICAL CONTROL II SUBIC TACTICAL DISPLAY REQUIREMENTS. (General Dynamics, Electric Boat Division, SPD-59-001, January 1959, CONFIDENTIAL) AD-305 329

27. SHIP CONTROL VIII SINGLE-ELEMENT VS. TWO-ELEMENT DISPLAY IN TWO-DIMENSIONAL TRACKING. (General Dynamics Corporation, Electric Boat, Report No. SPD-59-003, February 1959)

28. PROJECT SUBIC. COMMAND CONTROL I. MULTIPLE DISPLAY MONITORING II. CONTROL-DISPLAY SPATIAL ARRANGEMENT. Wesley C. Blair and Herbert M. Kaufman. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-251200, Report No. P59-100; SPD59-082, November 1959, 15 p.) AD-231 616

The effect of varying display-control spatial arrangement and total signal frequency on monitoring proficiency was investigated. Three conditions of display and control separation, ranging from grouped to separated, were used, each with three displays and associated controls. A separate group of subjects (Ss) was used for each of the three display-control arrangements. Subjects were given two 15-min sessions a day for 5 days, a total of 10 sessions. For half the sessions Ss received high frequency tapes (60-20-4 signals) and for half, low frequency tapes (15-5-1 signals). Subjects pushed one set of control buttons to light and observe the displays and another set to report detections and reset signals. Only one display could be observed at a time. Reset times were recorded as measures of overall proficiency while frequency and duration of observing were taken as observation measures.

29. A PROPOSAL FOR A COORDINATED SUBMARINE-ELECTRONICS DESIGN PROGRAM. (Electric Boat, Report No. R-61-A-03, 3 January 1961, CONFIDENTIAL)

Contents include: SINS; Navigation Systems, Submarine; Control Systems, Shipboard; Communication/Control Systems; Combat Information Centers; Submarine Systems; Submarines -- Control; Submarines -- Research.

30. PROJECT SUBIC. SHIP CONTROL X TRACKING IN THE HORIZONTAL PLANE WITH A CONTACT ANALOG DISPLAY. Bret A. Charipper. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Electric Boat Technical Report SPD 59-083, August 1959, 9 p.) AD-231 615

Five inexperienced male subjects were required to steer a simulated submarine along a ~~one-~~surface contact analog roadway for five sessions. The roadway was approximately 137.4 scale ft. wide and 100 scale ft. below the submarine. The contact analog was mounted in the Electric Boat Submarine Simulator which provided the vestibular/kinesthetic cues of roll and the equations of motion of a SKIPJACK class submarine traveling at 16 knots.

On the fifth day, photographic records were taken at 1-second intervals of the simulated submarine's position relative to the white center line of the roadway. Data for two subjects were lost due to a malfunction of the recording camera.

From the data of the remaining three subjects, it was concluded that operators can follow a prescribed path in the horizontal plane using a contact analog roadway. It was also concluded that inexperienced subjects can reach a high level of performance (80-100% time on the roadway) by at least the fifth session (102 minutes of practice).

31. SUBIC. ENGINEERING CONTROL: I. MULTIPLE DISPLAY MONITORING. A. E. Hickey and W. C. Blair. (General Dynamics Corporation, Electric Boat Division, Technical Report No. SPD 59-002, January 1959)

32. PROJECT SUBIC. SHIP CONTROL III. DEPTH SEEKING AND DEPTH KEEPING WITH A ONE-SURFACE CONTACT ANALOG DISPLAY. Raymond C. Sidorsky and John M. Newton. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-251200, Technical Report No. 411 HF-16; P58-133, August 1958, 14 p.) AD-204 395

Seven operators (four submarine officers and three civilians) effected two types of maneuvers in a simulated submarine situation using only the information presented in a one-surface Contact Analog display. The maneuvers were: (1) changing depth 200 ft up or down (depth seeking) and (2) hold a constant depth while counteracting a forcing function (depth keeping). The experiment was confined to a study of the visual cues of the Contact Analog and did not include the vestibular-kinesthetic cues normally present in the submarine. Eash operator was given ten 3-min trials in both depth keeping and depth seeking over a five-day period.

33. PROJECT SUBIC. SHIP CONTROL VII. JUDGEMENT OF PITCH WITH VISUAL NON-VISUAL CUES. Bret A. Charipper. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-251200, Technical Report No. 411 HF-14; P58-109, 1 July 1958, 13 p.) AD-201 476

Thirty male subjects, 15 in each of two experimental conditions, were rotated in the pitch plane to 20 angles spaced in 4° intervals over a range of plus 40° to minus 40°. Each subject made and reported verbally two judgements at each angle, which resulted in a total of 30 judgements per angle in each condition. The judgements of the subjects in Condition II were based on both the visual cues of a contact analog display and the vestibular-kinesthetic cues of body tilt. It was found, that with vestibular-kinesthetic cues alone, the subjects generally underestimated both up and down pitch angles and that, on the average, the size of their errors tended to increase with the size of the pitch angle. When given visual cues in addition to the vestibular-kinesthetic cues, however, subjects were usually more accurate in their estimates and showed relatively little increase in error as the pitch angle increased.

34. PROJECT SUBIC. SHIP CONTROL V. THE EFFECTS OF MOTION AND NUMBER OF SURFACES ON DEPTH CONTROL WITH A CONTACT ANALOG DISPLAY. Raymond C. Sidorsky and John M. Newton. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-251200, Technical Report No. SPD 59-010; P59-012, February 1959, 9 p.) AD-213-618

Five submarine officers controlled a simulator which incorporated a Contact Analog (CA) display and a single joystick control. They were required to make 200-ft depth changes under four different display conditions. Each operator made 20 depth changes with a one-surface CA and 20 with a two-surface CA. Forward motion was shown during ten of the trials with each type of CA but omitted during the other ten. Each trial was 180 seconds in length. The maneuvers consisted of depth changes only; no changes in heading or speed were involved. Three criteria were used to evaluate performance under the four experimental conditions. These were: (1) depth error at time 180 seconds; (2) greatest depth error after time 60 seconds; and (3) time within ± 30 ft. or ordered depth. Each of these three measures was subjected to a separate analysis of variance.

35. PROJECT SUBIC. SHIP CONTROL IX. AN EVALUATION OF A HORIZON-AT-INFINITY IN A CONTACT ANALOG DISPLAY. Raymond C. Sidorsky and Frederick L. Allen. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract None-251200, Report No. P59-140, SPD 59-084, August 1959, 11 p., 10 refs.) AD-231 615

The value of the display of a horizon-at-infinity as an aid in depth control with a Contact Analog (CA) Display was investigated. Three experimental displays were used: (i) a basic two-surface CA, (ii) the basic CA with a horizon-at-infinity, and (iii) the horizon-at-infinity without the associated CA surfaces. Twenty-one subjects were divided into 3 equal groups and each was tested on a different display. The task involved changing the depth of a simulated submarine using only the information available in the experimental display. The results indicate that additional cues of depth provided by the addition of a horizon-at-infinity result in a statistically signifacant inprovement in depth discrimination. However, although the improvement is statistically significant, performance is still not at a level of precision which would make operational adaptation of a Contact Analog display feasible.

36. COMMAND INFORMATION AND CONTROL REQUIREMENTS. W.S. Vaughan, Jr. (Human Sciences Research, Inc., Report No. H SR-RR-59/2-DD, September 1959, CONFIDENTIAL)

Contents include: ASW (Model); SUBIC (Model); Submarines - Research; Displays, optical; Displays, tactical; Control systems, closed loop; Submarines - Control; Submarines - Evasion characteristics.

37. FINAL REPORT FOR SUBIC WEAPONS CONTROL INFORMATION REQUIREMENTS STUDY. (IBM, 3-260-3667, 19 July 1959, SECRET)

38. SUBIC WEAPONS CONTROL SYSTEM INFORMATION REQUIREMENTS STUDY FINAL REPORT. (Librascope, Report No. FR-59-G-31, 31 July 1959, CONFIDENTIAL)

Contents include: SUBIC (Model); Control systems, weapons; Submarines - Evasion characteristics; Displays, optical; Displays, tactical; submarines - Control; Submarines - Research; Tactical control systems.

39. SUBIC SHIP CONTROL INTERIM COMPUTER STUDY. Curtis E. Gittings. (Librascope Inc., Glendale, California. Subcontract to General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-251200, Report No. L-07092-(A), 26 May 1960, CONFIDENTIAL) AD-317 728

Mathematical techniques are developed for the control of the lateral and longitudinal motion of modern high-speed submarines using conventional submarine control surfaces. These techniques permit efficient depth changing and course changing without undesired lateral-to-longitudinal coupling effects and within safe roll and pitch limits.

Confentional linear control methods and non-linear predictor or limit control methods are employed. An evaluation of the control methods based on a six degree of freedom digital simulation is included. A discussion of instrumentation requirements is also included.

SECTION A

Submarines

2. Study of Submarine Noise

40. SUBMARINE HYDRAULICS...DESIGNING FOR SAFETY AND SILENCE. (Applied Hydraulics & Pneumatics, Vol. 13, No. 2, February 1960, pp. 62-65)

Reliability and low noise level are two principles which guide submarine designer; hydraulic system has many fail-safe features to insure safety of crew and equipment; main system, vital system, and lead system supply fluid at 3000 psi to various ship operations; hydraulic components for system operation; circuit diagram of three pump-accumulator systems.

41. LATERAL VIBRATIONS IN RECIPROCATING MACHINERY. C. M. Lowell. (ASME Paper No. 58-A-79 for meeting 30 November-5 December 1958, 13 p.)

Author points out coupling between torsional and lateral vibration in reciprocating machinery; development of test apparatus which made possible control of variables involved; calculations valuable to engine and compressor builders as well as to manufacturers of other types of reciprocating machinery.

42. ADDED MASS MOMENT OF INERTIA INDUCED BY TORSIONAL VIBRATION OF SHIPS. T. Kumai. (European Shipbuilding, Vol. 7, No. 6, 1958, pp. 147-153)

Investigation of prism having sections similar to hull sections on water to obtain information for estimating natural frequency of torsional vibration of ships; special consideration is given to effect of draft; formula for estimation of added mass moment of inertia induced by torsional vibration of tanker, for example, is deduced for use in design room.

43. PROJECT SUBIC: TACTICAL CONTROL I. ANALYSIS OF INFORMATION REQUIREMENTS. Francis J. Wuest and John M. Newton. (General Dynamics Corp., Electric Boat Division, Groton, Connecticut, Contract Nonr-2512(00), Technical Report No. 411, November 1958, 23 p., CONFIDENTIAL) AD-304 809

A method for determining the information requirements of a human operator in cases where experienced operators are not available for usual interview techniques is presented. The method described is well suited for applications in the submarine tactical control loop. Because of rapid advances in the development of submarine tactical control equipment there are few officers experienced with the latest sonar, weapons, communications and fire control. The technique recommended and described for determining information requirements, therefore, is to present a submarine officer with a laboratory simulation of the tactical problem to be investigated. In the laboratory exercise, a minimum amount of information is presented to the subject on a simplified analog display. All specific information, including any items not presented in the display, are then made available at the subject's request. Items of requested information are recorded and analyzed. Results of an application of this method to a typical ASW problem are presented, and advantages and shortcomings of the method are discussed.

44. DOPPLER SONAR NAVIGATION STUDY. (General Electric Co., Syracuse, New York, Contract NObsr-72647, Interim Development Report No. 1, 15 February-15 May 1957, 28 October 1957, 114 p., CONFIDENTIAL) AD-309 129L

All requests require approval of Chief, Bureau of Ships, Navy Dept., Washington 25, D. C., Attn: Code 312.

45. MODEL TESTS FOR DETERMINING CRITICAL VIBRATIONS OF RUDDERPOST OF "MARINER" RUDDER. R. Wereldsma. (International Shipbuilding Progress, Vol. 6, No. 57, May 1959, pp. 187-195)

Investigation of bending and torsional vibration phenomena; laws of mechanical similarity which must be satisfied in tests; it appears from measurements of tension amplitudes that excitation of rudder by helicoidal tip vortices of propeller is not exactly harmonic but that it also contains noise element; added mass of rudder could be established from measurements. Paper before Delft Conference of Inst Physics.

46. NOTE ON PROPELLER-EXCITED HULL VIBRATIONS. A. J. Tachmindji and R. T. McGoldrick. (Journal of Ship Research, Vol. 3, No. 1, June 1959, pp. 28-35, 27 refs.)

Summary of information and techniques available for predicting levels of service vibration of ship in design stage; this involves estimating exciting forces and vibratory response of hull to given forces; it is emphasized that reliability depends on availability of data for ships actually in operation as standard of comparison.

47. ELIMINATING GEAR WEAR ON C4 VESSELS. J. J. Murphy. (Marine Engineering, Vol. 64, No. 2, February 1959, pp. 79-81+)

Analysis of vibratory problem which occurred in propulsion units of World War II C4-S-A4 vessels; mode of vibration was longitudinal, in which propeller excited propulsion gears in fore and aft direction, and was resolved by substitution of five-bladed propeller for four-bladed unit; propulsion unit consists of nested, double reduction gear driven by cross compound H-P and L-P turbines, nominally rated 9000 shp at 85 turns.

48. DOOR OPEN TO 'LOW-TEMP' THERMIONICS. William Beller. (Missiles and Rockets, 31 July 1961, p. 24)

FICO-built converter spells longer life for cells using readily available materials; a step toward noiseless subs.

The cells may be bringing the Navy a little nearer to realizing its dream of a noiseless submarine powerplant. It may also mean that solar thermionic power generators will become easier to design. And "low-temperature" thermionics undoubtedly can open up many applications not practical with present cells.

49. NEW FLEET OF MIDGET SUBS. (News Item from Naval Research Reviews, 1959, p. 28)

The Navy is getting a whole fleet of new "submarines." They look very much like torpedoes, being comparable in size, but maneuver and sound like submarines. They are submarine target simulators (built by Clevits Corporation) 11 feet long, 10 inches in diameter, weighing 344 pounds.

The new device can be launched from ships and helicopters and even through a large sub's torpedo tubes with the use of an adapter. Able to travel up to 10 knots for two hours on rechargeable batteries, they can dive, turn, and maneuver like the real thing. They also sent out engine noises and sonar signals to aid in target practice and in recovery. The use of this device in training naval forces in antisubmarine warfare will enable the Navy to use conventional submarines in jobs they were meant for, rather than as targets for ASW training.

50. VIBRATION ISOLATION FOR SUBMARINE MACHINERY. A.C. Summers. (Noise Control, Vol. 6, No. 4, July-August 1960, pp. 10-12)

Outline of design proceedings for solving problem of isolating machining vibrations from surrounding medium; present design control procedure; developments toward improvement.

SECTION A

Submarines

3. Model Tests and Sea Trials

51. LAUNCHING OF THE ROBERT E. LEE (SSB(N)601); ILLUSTRATIONS WITH TEXT. (American Society of Naval Engineers Journal, Vol. 72, February 1960, p. 8)

52. FIRST DAYS OF MARK I. E. E. Kintner. (American Society of Naval Engineers Journal, Vol. 72, No. 1, February 1960, pp. 9-13)

Information on construction and testing, including simulated under-ocean run, of STR (Submarine Thermal Reactor,) MARK I, which served as land-based prototype for USS Nautilus.

53. CAPABILITIES AND FACILITIES FOR SUBIC PROGRAM. (Autonetics, a division of North American Aviation, Inc., Downey, California, Report No. EM-5561, 21 October 1958, CONFIDENTIAL)

Contents include: SUBIC (Model); Submarine systems.

54. PROPOSED SUBMARINE COMMAND LOOP INFORMATION REQUIREMENTS STUDY FOR ELECTRIC BOAT. (Autonetics, a division of North American Aviation, Inc., Downey, California, Report No. EM-5560, 21 October 1958, CONFIDENTIAL)

Contents include: Submarine systems; SUBIC (Model)

55. PROPOSED SUBMARINE SHIP CONTROL INFORMATION REQUIREMENTS STUDY FOR ELECTRIC BOAT. (Autonetics, a division of North American Aviation, Inc., Downey, California, Report No. EM-5558, 21 October 1958, CONFIDENTIAL)

Contents include: SUBIC (Model); Submarine systems

56. PROPOSED SUBMARINE WEAPONS CONTROL INFORMATION REQUIREMENTS STUDY FOR ELECTRIC BOAT. (Autonetics, a division of North American Aviation, Inc., Downey, California, Report No. EM-5559, 21 October 1958, CONFIDENTIAL)

Contents include: SUBIC (Model); Submarine systems

57. POLARIS PROGRAM PROGRESS REPORT. (Autonetics, a division of North American Aviation, Inc., Downey, California, (Inertial Navigation product line), Report No. EM-2342-3, 1 November 1960, CONFIDENTIAL)

Contents include: POLARIS (Model); SINS (Model); Autonavigators, Submarine; Submarines, FBM; XN-7 (Model); Autonavigators, Inertial.

58. CLASSIFIED TITLE. R.A. Walker and J.Z. Menard. (Bell Telephone Laboratories, Inc., Whippany, N.J., Contract Nonr-246100, 7 December 1959, 16 p., TR No. 3, Proj. NR 261-111, SECRET) AD-318 592

Contents include: Submarines; Detection*; Tests; British Columbia.

59. TMB SYMPOSIUM ON BOUNDARY-LAYER-CONTROL SYSTEMS. (David Taylor Model Basin, Aero Report No. 876, February 1955, CONFIDENTIAL)

60. FEASIBILITY OF BOW PLANE REMOVAL ON FUTURE SUBMARINE DESIGNS DETERMINED FROM FULL-SCALE TRIALS OF USS ALBACORE (AGSS569). (David Taylor Model Basin, Report No. C-945, April 1958, CONFIDENTIAL)

Contents include: Submarines - Design; Submarines, auxiliary; ALBACORE (Model).

61. SUBMERGED TURNING AND MANEUVERING CHARACTERISTICS OF THE USS SKIPJACK (SSN 585) FROM FREE-RUNNING MODEL TESTS. (David Taylor Model Basin, Report No. C-1023, January 1959, CONFIDENTIAL)

Contents include: Submarines - Maneuvering; SKIPJACK (Model).

62. USS ALBACORE (AGSS569) VARIATIONS OF SHAFT TORQUE AND THRUST DURING STEADY STATE AND IN TURNS WHILE DEEPLY SUBMERGED. B.E. Bayles. (David Taylor Model Basin, Report No. C-877, January 1958, 31 p., CONFIDENTIAL.)

Available to U. S. Military Organizations only.

63. FULL-SCALE LONGITUDINAL DYNAMIC STABILITY, METACENTRIC MOMENT DERIVATIVE, AND EFFECTIVE MOMENT OF INERTIA CHARACTERISTICS OF USS ALBACORE (AGSS569) WITH SECOND STERN CONFIGURATION. Louis J. Belliveau. (David Taylor Model Basin, Report C-830, May 1957, CONFIDENTIAL)

64. THE RESISTANCE AND PROPULSION CHARACTERISTICS OF THE USS ALBACORE (AGSS 569). John L. Beveridge. (David Taylor Model Basin, Washington, Report No. C-569, August 1953, 66 p., CONFIDENTIAL)

A series of tests were conducted on TMB Model 4336 to determine the resistance and propulsion characteristics of the USS ALBACORE. The ALBACORE, formerly designated SST Scheme 4, represents the end result of efforts to provide a high-speed target for the evaluation of antisubmarine systems and weapons.
This report presents the test results pertaining to the resistance and propulsion characteristics of the ALBACORE up to and including the establishment of the contract design.

65. ANALOG COMPUTER STUDIES OF THE EFFECT OF INCREASING THE BOW PLANE ANGLE TO 25 DEGREES DIVE AT FULL POWER ON THE U.S.S. ALBACORE (AGSS569). J. W. Church. (David Taylor Model Basin, Letter C-21/2 ALBACORE, C-S8, 28 September 1955)

66. AN EVALUATION OF THE HANDLING QUALITIES OF THE SSN585, BASED ON SUBMARINE SIMULATOR STUDIES. J. W. Church. (David Taylor Model Basin, Report No. C-77 9, June 1956, CONFIDENTIAL)

The handling qualities of the SSN585, with fairwater planes (PD3292) are evaluated on the basis of definitive maneuvers in the vertical plane computed on the David Taylor Model Basin submarine simulator facility. These maneuvers are designed to reflect both the physical capability of the submarine alone and the degree to which the vessel may be controlled by the human operator. The trajectories are compared with those computed for the operational submarine SS569 and for the SSN585 with bow planes. It was found that the SSN585 with fairwater planes has about the same degree of dynamic stability at all speeds as the SS569 and that other handling qualities are also comparable to those of the SS569. The use of fairwater planes was found to be superior to use of conventional bow planes. A modest improvement in performance may be obtained by increasing the plane deflection rates to about 10 degrees per second.

67. CLASSIFIED TITLE. James W. Church. (David Taylor Model Basin, Washington, D. C., Report No. C-874, September 1957, 28 p., 10 refs., CONFIDENTIAL) AD-303 174L

Submit request via Chief, Bureau of Ships, Navy Dept., Washington 25, D. C.

68. USS NAUTILUS SS(N)571 STANDARDIZATION TRIAL COMPARISON WITH MODEL PREDICTIONS. John J. Foster. (David Taylor Model Basin, Washington, D. C., Report No. C-974, Research and Development Report., July 1958, 18 p., CONFIDENTIAL) AD-303 311L

Available to U. S. Military organizations only.

Standardization trial data have been compared with predictions from model tests for the USS NAUTILUS (SS(N)571). Comparisons of shaft revolutions, ship speed, shaft horsepower, thrust, and propulsive coefficients of the submarine and model are presented for both surfaced and submerged conditions.

69. DAVID TAYLOR MODEL BASIN SUBMARINE SIMULATOR FACILITY. D.L. Greenberg. (David Taylor Model Basin report, September 1958.)

70. A FULL-SCALE EVALUATION OF THE HANDLING QUALITIES OF USS ALBACORE (AGSS569) WITH THE FIRST STERN CONFIGURATION. Franklin Hawkins. (David Taylor Model Basin, Report No. C-732, June 1956, CONFIDENTIAL)

71. USS ALBACORE (AGSS569) WITH SECOND STERN CONFIGURATION TACTICAL CONDITION. James A. Heffner. (David Taylor Model Basin, Washington, D. C., Research and Development Report No. C-859, September 1957, 14 p., CONFIDENTIAL) AD-303 354L

Available to U. S. Military Organizations only.

72. USS RATON (SSR270) SPECTRUM ANALYSIS OF MOTION DATA FROM SEA TRIALS—TESTS 21-25 PRELIMINARY RESULTS, PART III. S. E. Lee. (David Taylor Model Basin, Washington, D. C., Report No. 1250, Research and Development Report, June 1958, 45 p.) AD-205 656L

Available to U. S. Military Organizations only.

73. A SIMULATOR EVALUATION OF THE HANDLING QUALITIES OF THE TRITON SSR(N)586 IN THE VERTICAL PLANE. Alan G. Lewis. (David Taylor Model Basin, Washington, D. C., Report No. C-897, Research and Development Report., February 1958, 43 p., 13 refs., CONFIDENTIAL) AD-303 290L

Available to U. S. Military Organizations only.

The handling qualities of the contract design of the TRITON, SSR(N)586, are evaluated on the basis of definitive maneuvers in the vertical plane computed on the Submarine Simulator Facility at the David Taylor Model Basin. These maneuvers are designed to reflect the inherent performance of the submarine as well as the degree to which it may be controlled by human operator or automatic control. The trajectories of the TRITON are compared with those computed for the USS ALBACORE with the second stern configuration (ALBACORE II). Several modifications of the subject submarine are investigated including increase in stabilizer span, metacentric height, and stern plane deflection rate. It is found that the handling qualities of the TRITON, although inferior to those of ALBACORE II, are satisfactory for a submarine of such large size, and for the performance of its primary mission. Several changes to the contract design are recommended however, which should improve submerged vertical plane performance.

74. THE WHIPPING RESPONSE OF A SIMPLE SUBMARINE MODEL TO UNDERWATER EXPLOSIONS AT VARIOUS DEPTHS. Richard W. Mayo, T. Francis Ogilvie, and George Chertock. (David Taylor Model Basin, Research and Development Report, Report No. C-802, December 1957, 31 p., CONFIDENTIAL) AD-303 294L

75. CLASSIFIED TITLE. Robert K. McCandliss. (David Taylor Model Basin, Washington, D. C., Report No. C-939, Research and Development Report, August 1958, 21 p., CONFIDENTIAL) AD-303 298L

Available to U. S. Military Organizations only.

76. CLASSIFIED TITLE, O. C. Niederer and D. B. Young. (David Taylor Model Basin, Report No. C-635, January 1956, 51 p., CONFIDENTIAL.) AD-307 321

77. MODEL TURNING AND MANEUVERING TESTS OF THE USS SKATE (SSN578) FOR SURFACE AND SUBMERGED CONDITION. C. R. Olson. (David Taylor Model Basin, Report No. C-838, March 1957, 16 p., CONFIDENTIAL.) AD-145 533

78. CLASSIFIED TITLE. C.R. Olson. (David Taylor Model Basin, Report No. C-935, March 1958, 18 p., CONFIDENTIAL) AD-303 175L

Available to U. S. Military Organizations only.

79. SUBMERGED TURNING AND MANEUVERING CHARACTERISTICS OF THE SSBN (FBM) 598 SUBMARINE FROM FREE-RUNNING MODEL TESTS. C. R. Olson. (David Taylor Model Basin, Report No. C-973, June 1958, CONFIDENTIAL) AD-303 233L

Available to U. S. Military organizations only.

80. TACTICAL TRIALS OF USS SAILFISH (SSR572). B. G. Pifer. (David Taylor Model Basin, Report No. C-967, June 1958, 19p., CONFIDENTIAL) AD-303 194L

Available to U. S. Military Organizations only.

81. A REPRESENTATION OF THE SUBMERGED DYNAMIC BEHAVIOR OF SUBMARINES; PROPOSED FOR THE SPECIAL DEVICES CENTER SUBMARINE SIMULATOR. L. Pode and J. W. Church. (David Taylor Model Basin, Rept. C-661, November 1959, CONFIDENTIAL.)

82. USS NAUTILUS (SS(N)571) ACCELERATION AND DECELERATION CHARACTERISTICS AND STEERING GEAR PERFORMANCE IN TURNS. Paul V. Ruscus. (David Taylor Model Basin, Washington, D.C., Report No. C-997, Evaluation Test Report, October 1958, 14 p., CONFIDENTIAL) AD-306 253L

Available to U.S. Military Organizations only.

This report represents results of acceleration and deceleration trials on the USS NAUTILUS (SS(N)571) for both surfaced and submerged operations. Shaft torque, thrust, RPM, astern steam chest pressure, main condenser vacuum, steam generator drum pressure, and first stage turbine shell pressure are plotted against time for surfaced and submerged operations. In addition, instantaneous speed and reach are plotted for surfaced operation. Data taken during a hard right turn at full power are represented in curves of shaft RPM, torque, thrust, rudder angle, and change of heading versus time.

An attempt was made to record rudder ram pressures during turns, but the records obtained were obviously in error and, therefore, are not included in this report. The data presented herein are considered valid. Test runs were precisely executed and the instrumentation, with the one exception noted, functioned well.

83. COMPARATIVE SEAKEEPING TESTS AT THE DAVID TAYLOR MODEL BASIN, THE NETHERLANDS SHIP MODEL BASIN, AND THE ADMIRALTY EXPERIMENT WORKS. George P. Stefun. (David Taylor Model Basin, Washington, D.C., Report No. 1309, May 1960, 35 p.) AD-238 625

Comparative results are presented of seakeeping tests on a model in waves run at the David Taylor Model Basin, the Netherlands Ship Model Basin, and the Admiralty Experiment Works. A brief description is given of the test methods used by the three tanks in connection with the test program initiated by the International Towing Tank Conference. The results of the wave tests are compared with respect to resistance, shaft rpm, heave amplitude, pitch amplitude, and phase-angle measurements. The comparisons indicate that fair agreement among the three tanks exists for most of the test conditions, but somewhat large discrepancies exist for conditions of low model speeds and for large wave amplitudes. The reasons for discrepancies are discussed together with recommendations for improved correlations for future seakeeping test results.

84. USS TROUT (SS566) STANDARDIZATION TRIAL ANALYSIS AND COMPARISON WITH PREDICTIONS FROM MODEL TESTS. C.J. Wilson and W.T. Potter. (David Taylor Model Basin, Report No. C-921, March 1958, 28 p., CONFIDENTIAL) AD-303 193L

Available to U.S. Military Organizations only.

85. SUBIC. (Electric Boat, Report No. CEB-304, 30 June 1957, CONFIDENTIAL)

Contents include: SUBIC (Model); Submarine systems

86. STATUS REPORT, August 15, 1958. (Electric Boat, Report No. CEB-415, 15 August 1958, CONFIDENTIAL)

Contents include: SUBIC (Model); Submarine systems.

87. ENGINEERING CONTROL I MULTIPLE DISPLAY MONITORING. (Electric Boat, Report No. SPD-59-002, January 1959, UNCLASSIFIED.)

Contents include: SUBIC (Model); Displays, optical; Signals - Detection; Submarines - Detection; Displays, tactical; Submarines - Control; Submarines - Evasion characteristics; Submarines - Research; Tactical control systems.

88. STATUS REPORT PHASE II. (General Dynamics Corporation, Electric Boat Division, Report No. CEB-0733, 15 August 1958-15 August 1959, CONFIDENTIAL)

89. SHIP CONTROL VI STEERING AND DIVING A SUBMARINE WITH A CONTACT ANALOG DISPLAY. Raymond C. Sidorsky. (Electric Boat, Report No. TR-411-HF-20, December 1958, UNCLASSIFIED)

Contents include: SUBIC (Model); Displays, visual; Displays, optical; Simulators, submarine; Submarines -- Testing; Displays, tactical; Submarines -- Research; Submarines -- Control; Submarines -- Evasion characteristics; Tactical control systems.

90. SHIP CONTROL VIII SINGLE-ELEMENT VS. TWO-ELEMENT DISPLAY IN TWO-DIMENSIONAL TRACKING. Bret A. Charipper. (Electric Boat, Report No. SPD-59-003, February 1959, UNCLASSIFIED.)

Contents include: Displays, optical; SUBIC (Model); Tests, performance; Submarines -- Testing; Displays, tactical; Submarines -- Control; Submarines -- Evasion characteristics; Submarines -- Research; Tactical control systems.

91. PROJECT SUBIC. SHIP CONTROL XI. STEERING AND DIVING WITH THE COMBINED INSTRUMENT PANEL AND A CONTACT ANALOG-ROADWAY DISPLAY. Wesley C. Blair and Dean W. Plath. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-251200, Report No. P60-128, Technical Report No. SPD 60-078, September 1960, 21 p.) AD-250 362

Three independent groups of five inexperienced male subjects were required to seek and keep course and depth simultaneously. Each group was tested on one of three ship control displays: a combined instrument panel, a contact analog-roadway display with error information. The displays were mounted in the electric boat submarine simulator which was programmed for Skipjack equations at 20 knots. Time on depth, on course, and on both simultaneously were recorded. From the results it was concluded that the CIP display was superior to the others as a source of information for ship control. It was also concluded that the order interpretation of the CA was superior to the error interpretation.

92. CLASSIFIED TITLE. V. T. Boatwright, Jr. (General Dynamics Corporation, Electrical Boat Division, Groton, Connecticut, Contract Nonr-251200, Technical Report No. 411 OR 1, P58-107 (CEB413), 30 June 1958, 32 p., CONFIDENTIAL) AD-301 208

93. SUBIC. MARINE POWERPLANT SIMULATION BASIC MODEL. Cort DeVoe, Thomas Downie, and others. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-251200, Report No. CSD59-004, 30 April 1959, 85 p.) AD-218 519

The complete simulation of complex vehicles by large scale computers has been used extensively in the mis ile field with excellent results. In general, this technique has required the combined use of analog and digital computers. The major advantage of a simulation program of this type is to permit the study of complex control and vehicle performance problems by exhaustive evaluation of alternative solutions. This report summarizes the work done to date toward applying this technique to submarine control problems.

94. SUBIC MARINE POWERPLANT SIMULATION COMPUTER CONTROL. Cort Devoe, Thomas Downie, and Richard Wright. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-251200, Report No. CSD 59-006, 15 June 1959, 27 p.) AD-218 986

Problems in the submarine's engineering control loop are discussed. The major problem is defined along with several alternative solutions. A definition of the functions to be performed by a computer, which would aid in alleviating this problem is given. A derivation of the method of analysis to be performed by the computer is followed by the simulation of the computer exercising control of an electric motor driving a propeller through varying field current in the motor only.

95. CLASSIFIED TITLE. Francis J. Wuest. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-251200, Technical Report No. SPD 59-001, P56-008, January 1959, 27 p., 10 refs., CONFIDENTIAL) AD-305 329

96. CLASSIFIED TITLE. F.A. Gaynor, J.J. Fleck, and F.R. Fowler. (General Electric Company, Pittsfield, Mass., Contract NObs-72303, Interim Development Report No. 2, 1 August - 15 September 1957, CONFIDENTIAL) AD-154 861

97. 'JEEP OF THE DEEP' NEARS FIRST U.S. SEA TRIALS. Michael Getler. (Missile and Rockets, Vol. 10, No. 3, 15 January 1962, pp. 32-33)

Loral Electronics opens new Florida test facility; one- and two-man vehicles have clear military merit.

98. SUBMARINE TOPOGRAPHY OF THE WESTERN STRAITS OF FLORIDA. G. F. Jordan and H. B. Stewart, Jr. (Geological Society Bulletin, Vol. 72, June 1961, pp. 1051-1058, Bibliog.)

99. POLARIS PROGRAM. Seabrook Hull. (Missile Design & Development, January 1961, pp. 20-23+)

An interview with Vice Admiral W. F. Raborn, Jr., U. S. N.

100. 'PRIVATE OCEAN' FOR POLARIS. (Missiles and Rockets, 9 January 1961, pp. 16-18)

Models tested at Lockheed's LUMF saved money, proved out feasibility of missile's launch method.

101. NEW OCEANOGRAPHIC SUB SCHEDULED. (News Item from Missiles and Rockets, 2 October 1961, p. 9)

General Dynamics' Electric Boat Division will build Aluminaut, an oceanographic research submarine designed to operate at depths of 15,000 ft., for Reynolds International at a price of $2 million. Fifth feet long and with an operating range of 80 miles, it is the first sub ever to be built of aluminum. Launch date: 1963.

102. UNDERWATER FACILITY. (Missiles & Space, News Item, April 1961, p. 33)

Thousands of launch tests of sub-scale Polaris missiles are conducted in Lockheed's underwater missile facility, Sunnyvale, California. Encased in a pressure hull, the 85 ft. tank can be reduced in atmospheric pressure to simulate the differential between sea surface and a submerged submarine. Tank also generates waves to duplicate, in scale, a near-hurricane-force sea. Trajectory of dummy missiles is viewed by a remotely operated television camera and three high-speed movie cameras, while performance data are recorded on an oscillograph.

103. A SUBMARINE SIMULATOR DEVICE PROGRAM. Robert H. Dickman, U. S. Naval Training Device Center, Port Washington, New York. (4th National Convention on Military Electronics, Conference Proceedings, 27-29 June 1960, Washington, D. C., CONFIDENTIAL)

104. CLASSIFIED TITLE. S. Brittingham. (Naval Boiler and Turbine Laboratory, Philadelphia, Pennsylvania, NB TL Test No. T-275, 27 February 1959, 7 p., CONFIDENTIAL) AD-312 722L

Only Military Offices may request from ASTIA. Others request approval of Chief, Bureau of Ships, Navy Department, Washington 25, D. C.

105. PROTOTYPE EVALUATION TESTS OF BOW PLANES ANGLE INDICATOR, HENSCHEL CORPORATION, CONTRACT NObs-74210. K.N. Dick. (Naval Engineering Experiment Station, Annapolis, Maryland, EES Report No. 830070B, 26 January 1959, 9 p.) AD-215 985L

Available to U.S. Military Organizations only.

106. CLASSIFIED TITLE. E. M. Herrmann. (Naval Engineering Experiment Station, Annapolis, Maryland, Research and Development Report No. 050081, 26 July 1957, 34 p., CONFIDENTIAL) AD-303 253L

Available to U. S. Military Organizations only.

107. CLASSIFIED TITLE. W. S. Macleod. (Naval Engineering Experiment Station, Annapolis, Maryland, EES Test No. 050081, 6 December 1957, 5 p., CONFIDENTIAL)

Available to U. S. Military Organizations only.

108. POLARIS EVALUATION TEST PLAN USS COMPASS ISLAND (EAG-153) TEST PERIOD 20-60 7 THROUGH 17 OCTOBER 1960. (Navy N. Y. Naval Shipyard Test Per. 20-60, 7-17 October 1960.)

109. SUBMARINES SS565 AND SS566; CONTRACT NObs-2657 WITH GENERAL MOTORS CORPORATION: GENERAL ELECTRIC COMPANY, SUBCONTRACTOR FOR ELECTRICAL PROPULSION EQUIPMENT: PROPULSION CONTROL, NS 676-027. (New York Naval Shipyard, Material Laboratory, Brooklyn, Report No. 5483-2, 3 July 1953, 2 p.) AD-37 098

Investigation of the subject equipment was conducted at the Material Laboratory on 9 June 1953. The investigation was conducted to determine the minimum contact tip speed necessary to enable the contractor to interrupt heavy currents at 1000 volts dc.

The contractor, submitted by the General Electric Company, consisted of a single set of contacts as normally furnished in the propulsion control unit. The contactor was mounted in an angle iron frame and equipped with a variable speed motor drive mechanism for purposes of testing.

110. CLASSIFIED TITLE. C. J. Krieger and L. D. Morgan. (Navy Electronics Laboratory, San Diego, California, NEL Report No. 712, Supplement to Report No. 629, 19 December 1956, 16 p., CONFIDENTIAL) AD-303 011L

Available to U. S. Military Organizations only.

111. CLASSIFIED TITLE. (Navy Electronics Laboratory, San Diego, California, NEL Report No. 750, 25 May 1957, 44 p., CONFIDENTIAL) AD-302 978

112. CLASSIFIED TITLE. Gene B. Parrish and Alice Winzer. (Stevens Institute of Technology, Experimental Towing Tank, Hoboken, New Jersey, Contract N6onr-24705, Report No. 569, January 1959, 1 Vol., CONFIDENTIAL) AD-305 401

113. NOTS, SAN CLEMENTE ISLAND. Howard R. Talkington. (United States Naval Institute Proceedings, Vol. 86, No. 6, June 1960, pp. 92-101).

The first powered Polaris underwater launching was on the 14th of April 1960. This further step forward towards the operational readiness of the Polaris missile demonstrates one type of development work for which the facilities of the Naval Ordnance Test Station, San Clemente Island, have been designed. Aircraft torpedoes are another major test subject at San Clemente.

114. UTILIZATION OF SAN CLEMENTE ISLAND BY THE U.S. NAVAL ORDNANCE TEST STATION. (U.S. NAVY, Naval Ordnance Test Station, Report No. IDP-521 (Rev. 1), 2 September 1958, CONFIDENTIAL)

Contents include: Submarines - Testing; Ordnance, underwater.

115. U.S.S. THEODORE ROOSEVELT SSBN-600 PATROL NUMBER ONE SECTION LIMA MATERIAL PERFORMANCE DATA. (U. S. Navy, Report No. 61-I-15, 19 July-15 September 1961, CONFIDENTIAL)

Contents include: THEODORE ROOSEVELT (SUBMARINE) (MODEL); Submarines - Design; Submarines - Testing - Submarines - Equipment; Submarines - Fire Control Systems; Submarines - Performance.

SECTION A

Submarines

4. Analytical Studies of Stability and Control Investigations

116. HOW TO SNUB GYROSTABILIZER. J. T. Ellis, Jr. (Applied Hydraulics & Pneumatics, Vol. 13, No. 3, March 1960, pp. 90-91)

Nomograph enables simplified determination of stopping force required for shock absorber to stop moving mass within required distance, at various velocities; description of shock absorber in gyrostabilizer used to reduce roll in ballistic missile submarines.

117. SHIP CONTROL INFORMATION STUDY (SUBIC). Leonard Bogdon, Edmund Rynaski, and others, (Cornell Aeronautical Laboratory, Inc., Buffalo, New York, [Subcontract to General Dynamics Corporation, Electric Boat Division, Groton, Connecticut,] Contract Nonr-251200, Report No. IM-1306-V-2, Final Report, 31 July 1959, 1 volume) AD-231 249

Information requirements for submarine control were formulated for depth-changing and course-changing maneuvers. These requirements were determined on the basis of the optimum trajectories (limit maneuvers) that can be executed with an Albacore hull. The use of automatic control (to augment the frequency response of the submarine) permitted the determination of limit maneuvers in the vertical and horizontal planes as a function of speed and magnitude of the ordered change. In all cases, the objective was to minimize the time to effect a path change, subject to certain pitch angle and trajectory overshoot restrictions. Examination of the control system, synthesized for the performance of limit maneuvers, established information flow, data processing and time histories of control actions. These data were used to determine the optimum location of the human operator in the ship-control loop and to further specify his specific information and data-processing requirements.

118. DYNAMIC LONGITUDINAL STABILITY OF A SUBMARINE. (David Taylor Model Basin, Report No. C-158, October 1948, UNCLASSIFIED)

Contents include: Submarines - Control; Stability, dynamic; Stability, longitudinal.

119. AN EVALUATION OF THE HANDLING QUALITIES OF THE SSN585, PD3292, BASED ON SUBMARINE SIMULATOR STUDIES. James W. Church. (David Taylor Model Basin, Report No. C-779, June 1956, 34 p., 14 refs., CONFIDENTIAL) AD-145 452

120. SUBMERGED BEHAVIOR OF THE T-CLASS SUBMARINE, A REPORT OF PERFORMANCE TESTS ON THE USS MARLIN. James W. Church. (David Taylor Model Basin, Letter C-55, 16 January 1957.)

121. MEASURES OF PERFORMANCE OF USS THRESHER (SSN 593) BASED ON MOTION SIMULATION. J.W. Church. (David Taylor Model Basin, Report No. C-1245, January 1961, 17 p., CONFIDENTIAL)

Certain measures of performance of the USS THRESHER (SSN 593) are evaluated on the basis of definitive maneuvers computed on a simulation facility. Predictions are made of the overshoot in depth during a high-speed dive, the relation between steady dive angle and recovery depth, the snap roll angle associated with a high-speed turn and the effect on casualty recovering of using fairwater planes, stopping the propeller, and blowing ballast water.

122. A FULL-SCALE EVALUATION OF THE HANDLING QUALITIES OF USS ALBACORE (AGSS569) WITH THE SECOND STERN CONFIGURATION. P.C. Clawson. (David Taylor Model Basin, Research and Development Report, Report No. C-827, May 1957, 39 p., 4 refs., CONFIDENTIAL)

The handling qualities of the USS ALBACORE (AGSS569) with a second stern configuration are evaluated on the basis of measurements taken during definitive maneuvers of the full-scale submarine. Comparison is made with results obtained in similar tests on ALBACORE with the first stern configuration. In submerged vertical maneuvers, ALBACORE II has less dynamic stability and more stern plane control effectireness than ALBACORE I. In the horizontal plane, ALBACORE II is dynamically unstable on course but has 65 percent of the steady-turning diameter of ALBACORE I. There is not significant difference in handling on the surface. Emergency recovery tests indicate that above 20 knots, with a stern plane jam on 10 degrees or higher, recovery on ALBACORE II would be doubtful. A similar problem existed with ALBACORE I, and some suggestions are given for overcoming this situation.

123. MODEL INVESTIGATION OF THE STABILITY AND CONTROL CHARACTERISTICS FOR AHEAD AND ASTERN MOTIONS OF USS ALBACORE (AGSS569) WITH SECOND STERN CONFIGURATION. J.J. Foster, E. Dempsey, and J.L. Johnson. (David Taylor Model Basin, Report, April 1958, CONFIDENTIAL).

124. THE INFLUENCE OF METACENTRIC STABILITY ON THE DYNAMIC LONGITUDINAL STABILITY OF A SUBMARINE. E. D. Hoyt and F. H. Imlay. (David Taylor Model Basin, Report No. C-158, October 1948)

125. PREDICTION OF DYNAMIC STABILITY DERIVATIVES OF AN ELONGATED BODY OF REVOLUTION. L. Landweber and J. L. Johnson. (David Taylor Model Basin, Report No., C-359, May 1951, CONFIDENTIAL)

See also reports no. C-385, C-661.

126. INVESTIGATION OF THE DYNAMIC STABILITY IN PITCH OF THE "GUPPY" CONVERSION OF THE SS475 CLASS SUBMARINE. O. C. Niederer, A. J. Volta, and E. D. Hoyt. (David Taylor Model Basin, Report No. C-124, July 1948, CONFIDENTIAL)

127. INVESTIGATION OF THE LONGITUDINAL DYNAMIC STABILITY AND CONTROL CHARACTERISTICS OF THE SST SCHEMES 1 AND 2 SUBMARINES. O. C. Niederer and P. C. Clawson. (David Taylor Model Basin, Report No. C-385, July 1951, CONFIDENTIAL)

128. MODEL-FULL SCALE CORRELATION OF THE HANDLING QUALITIES OF THE ALBACORE II IN THE HORIZONTAL PLANE AND THE EFFECT OF BRIDGE FAIRWATER REMOVAL, C.R. Olson. (David Taylor Model Basin, Report No. C-935, Hydromechanics Laboratory research and development report, March 1958, 23 p., CONFIDENTIAL)

Correlation studies have demonstrated that handling quality characteristics derived from trajectories of a 15-foot free-running model of USS ALBACORE II for submerged maneuvers in the horizontal plane agree closely with comparable full-scale trial data. Quantities such as tactical diameter, angle of heel and measures of directional stability are predicted with a high degree of accuracy. Additional free-running model tests have indicated that submerged handling qualities could be improved appreciably by removal of the bridge fairwater and the use of a more effective rudder. The most notable improvement is a more than 50 percent reduction of the excessive snap roll which is experienced by the ALBACORE II in sharp high-speed turns.

129. SUBMERGED TURNING AND MANEUVERING CHARACTERISTICS OF THE CONTRACT DESIGN OF THE SSN 585 SUBMARINE FROM FREE-TURNING MODEL TESTS. C. R. Olson. (David Taylor Model Basin, Research and Development Report, Report No. C-966, June 1958, 18 p., CONFIDENTIAL.) AD-303 292L

130. SUBMERGED TURNING AND MANEUVERING CHARACTERISTICS OF THE USS SKIPJACK (SSN 585) FROM FREE-RUNNING MODEL TESTS. C. R. Olson. (David Taylor Model Basin, Rept. C-1023, January 1959, CONFIDENTIAL.)

131. SUBMERGED TURNING AND MANEUVERING CHARACTERISTICS OF THE SSN 593 SUBMARINE FROM FREE-RUNNING MODEL TESTS. C.R. Olson. (David W. Taylor Model Basin, Report No. C-1088, July 1959, CONFIDENTIAL)

Contents include: Submarines - Maneuverability; Submarines - Model Test Results; Submarines - Performance.

132. AN ANALYSIS OF THE NONLINEARITIES IN THE DYNAMIC BEHAVIOR OF THE USS ODAX. L. Pode. (David Taylor Model Basin, Report C-532, October 1953, CONFIDENTIAL.)

133. A STUDY OF THE EFFECTS OF HULL AND CONTROL PARAMETERS ON THE PERFORMANCE AND STABILITY OF SUBMARINES IN PITCHING MOTION. L. Pode and J. W. Church. (David Taylor Model Basin, Report No. C-626, November 1954, CONFIDENTIAL) AD-87 157

134. FULL-SCALE EVALUATION OF THE STATIC STABILITY AND CONTROL DERIVATIVES OF THE USS ALBACORE (AGSS569) WITH SECOND STERN CONFIGURATIONS. W. L. Stracke. (David Taylor Model Basin Rept. C-829, October 1957, CONFIDENTIAL.)

135. SUMMARY OF SUBMERGED SUBMARINE TURNING DATA AND PREDICTION OF THE TURNING RADIUM OF THE SSN SUBMARINE AT 35 DEGREES RUDDER. H. Weiner and P. Golovato. (David Taylor Model Basin, Report. No. C-549, October 1952, CONFIDENTIAL) AD-303 774

136. MODEL INVESTIGATION OF THE STABILITY AND CONTROL CHARACTERISTICS OF THE PRELIMINARY DESIGN OF THE SSGN (FBM) SUBMARINE. D. B. Young. (David Taylor Model Basin, Report No. C-928, March 1958, CONFIDENTIAL)

137. MODEL INVESTIGATION OF THE STABILITY AND CONTROL CHARACTERISTICS OF THE SSBM 598 SUBMARINE. D. B. Young. (David Taylor Model Basin, Rept. C-991, September 1958, CONFIDENTIAL.)

138. MODEL INVESTIGATION OF THE STABILITY AND CONTROL CHARACTERISTICS OF THE CONTRACT DESIGN OF THE SSN 578-CLASS SUBMARINE. Donald B. Young. (David Taylor Model Basin, Washington, D.C., Report No, C-1003, NS715-084, Research and Development Report, October 1958, 69 p., 11 refs., CONFIDENTIAL) AD-306 260

139. STABILITY AND CONTROL OF DEEPLY SUBMERGED SUBMARINES: DISCUSSION. (Engineer, Vol. 211, 28 April 1961, p. 706)

140. NEW GYROS FOR OUR SUBMARINES. F. D. Braddon. (Franklin Institute Journal, August 1960, p. 79)

141. SUBIC WEAPONS CONTROL. H. Uchiyamada and E. S. Wolk. (General Dynamics Corporation, Electric Boat Division., Groton, Connecticut, Contract Nonr-251200, Report No. P59-078;5PD 59-037, Technical Report No. 1, 8 May 1959, 30 p., CEB-436, CONFIDENTIAL) AD-309 083

This report has been prepared by the Electric Boat Division as a technical report on the weapons control loop of the SUBIC program. The purpose of this report is two-fold:

1. To describe briefly all the published work in weapons control done to date at Electric Boat Division and to indicate the reference where each part may be found.
2. To report all progress made at Electric Boat Division in extending the weapons-control mathematical mode, since the last published report.

142. MANUAL RATIOED CONTROL OF THE AGSS569 SUBMARINE. William Barry and Richard S. Hollyer. (Massachusetts Institute of Technology, Servomechanisms Laboratory, Report No. 6968-ER-1, Engineering Report No. 1, 16 May 1952, 74 p., 12 refs., CONFIDENTIAL) AD-38 079

The performance of the AGSS569 submarine at maximum speed under manual ratioed control was investigated by means of an electrical analogue of the hull dynamics and mock-up of the instrumentation proposed for the vessel. The objectives of this thesis were to determine: (1) Controllability, (2) Method of control, (3) Effect on performance of instrumentation and control plane servo time lags, (4) Effect on performance of providing synthetic feel to the operator.

Performance was studied by observing system response to a sudden command to change depth by 20 feet, the results being evaluated on the basis of a performance index. Steady depth keeping was also observed and evaluated on the basis of RMS depth error.

143. BENDIX GETS POLARIS CONTROL AWARD. (News Item from Missiles and Rockets, 11 September 1961, p. 23)

Five automatic maneuvering control systems for POLARIS submarines will be built for the Navy by Bendix's North Hollywood California Division. The system control the submarine's steering and diving mechanism through a solid-state computer which receives signals from the speed, course and depth instruments. The computer in turn regulates electro-hydraulic valves in the steering, diving and fairwater planes.

144. FEASIBILITY STUDIES OF PRESSURE HULLS FOR DEEPLY SUBMERGED SUBMARINES. (National Research Council, Report No. CUW-0256, 3 October, 1958, CONFIDENTIAL)

Contents include: c.r. ASTIA AD-305 685; Warfare, submarine; Underwater research; Submarines - Design.

145. CONTRACT ACCEPTANCE TESTS OF PROTOTYPE COMBINED INSTRUMENT, SUBMARINE DIVING AND CONTROL EQUIPMENT, SPERRY PIEDMONT DIVISION, SPERRY-RAND CORPORATION, EXHIBITOR, CONTRACT NObs-73173. D. N. Dick and K. L. Benson. (Naval Engineering Experiment Station, Annapolis, Md., EES rept. no. 830053(5), 23 April 1958, 10 p., CONFIDENTIAL.) AD-306 513L

All requests require approval of Chief, Bureau of Ships, Navy Department, Washington 25, D. C., Attn: Code 312.

146. CONTRACT ACCEPTANCE TESTS OF COURSE ERROR INDICATOR OF PROTOTYPE COMBINED INSTRUMENT SUBMARINE STEERING AND DIVING EQUIPMENT, SPERRY PIEDMONT DIVISION, SPERRY-RAND CORPORATION, CONTRACT NObs-73173. A. E. Spencer and D. L. Benson. (Naval Engineering Experiment Station, Annapolis, Maryland, EES Report No. 830053(8), 2 October 1958, 5 p.) AD-212 879L

All requests require approval of Chief, Bureau of Ships, Navy Department, Washington 25, D. C.

147. A SUMMARY OF HYDRODYNAMIC COEFFICIENTS FOR A GROUP OF SUBMARINES. (Stevens Institute of Technology, Hoboken, New Jersey, Experimental Towing Tank Report No. 500, June 1953)

148. THE EFFECT OF CHANGES IN HYDRODYNAMIC COEFFICIENTS ON THE TRAJECTORIES OF REPRESENTATIVE SUBMARINES OPERATING WITH DIFFERENT TYPES OF CONTROLS. Gene Parrish and Alice Winzer. (Stevens Institute of Technology, Hoboken, New Jersey, Contract N6onr-247(05), Report No. 646, March 1958, 1 vol., CONFIDENTIAL) AD-153 108

This report presents a study of the effect of bow planes on the stability and control characteristics of submarines. The work extends that of Reference 1 to include bow planes. Suggestions are made as to requirements on the performance index for the operation of bow planes alone and also for the bow and stern plane operation.

149. USER'S POINT OF VIEW: NAVY REQUIRES THE UTMOST IN RELIABILITY. D. Kern, U. S. Navy, COMSUBLANT. (Underwater Engineering, Vol. 2, No. 1, January 1961, pp. 29-31)

Efforts by industry and our naval shipyards to make submarine hydraulic systems more reliable are not wholly motivated by a philanthropic desire to serve the Navy. The reputation of the submarine design and shipbuilding activity can rest to a very great extent on the performance of the hydraulic system.

Once a submarine is at sea, experience has taught us that nothing, except perhaps loss of main propulsion power, can be more disturbing to the submarine operator than loss of hydraulic power or repetitive hydraulic system failures continually jeopardizing the advertised performance of the system, or worse, the mission of the submarine.

150. DESIGN ENGINEER'S JOB: TO PROVIDE BUILT-IN RELIABILITY. W. H. Tisdale, Jr., General Dynamics Corp., Electric Boat Division. (Underwater Engineering, Vol. 2, No. 1, January 1961, pp. 25-28)

The engineer responsible for design of submarine hydraulic systems has many tools at his disposal to aid in attaining the ultimate goal of maximum reliability. In addition to feedback of information from operating vessels and other sources, the engineer must develop a few tools of his own.

One of these is hydraulic density ratio—an indication of the complexity of hydraulic systems designed into a particular submarine in any one year, relative to a base year.

151. THE INTERACTION BETWEEN SEA MOTION AND SHIP MOTION RESPONSE ON MISSILE UNDERWATER LAUNCHING SUCCESS PROBABILITY. George Mechlin. (Westinghouse Electric Corporation, Report No. TR-689, 22 May 1961, CONFIDENTIAL)

Contents include: Ships - Motion; Underwater Research; Submarines -- Stability; Submarines -- Control; POLARIS (General) (Model); Tides, Ocean.

SECTION A

<u>Submarines</u>

5. General Articles on Submarines

a. Marketing

152. PLAYING CHESS IN A DREAM: U. S. NAVY'S SUBMARINES. (Compressed Air Magazine, Vol. 65, October 1960, p. 29)

153. BIGGER, BETTER SUBS ARE COMING. (Missiles & Rockets, 25 July 1960, p. 31.)

154. POLARIS SUB COSTS RISING. (News Item from Missiles and Rockets, 19 June 1961, p. 9)

The pricetag on the new POLARIS-launching Lafayette Class submarines is $116.2 million. That is a jump of $11 to $19 million over the first two classes of nuclear-powered subs in the POLARIS program. About two-thirds of the cost of the subs is for shipbuilding, one-third for POLARIS system equipment.

155. GOP FAILS TO GET MORE POLARIS SUBS. (Missiles and Rockets, 29 May 1961, p. 27)

The House Republican Policy Committee sought to add six more POLARIS submarines to the $12.3 billion defense procurements authorization bill as it came up for action on the House floor.

The House passed the bill including $393 million for bombers added by the House Armed Services Committee on top of the request submitted by President Kennedy. The House rejected the GOP POLARIS amendment 105 to 58.

156. SUBMARINE HAS BIG EDGE OVER DEFENSE. Harry Sanders. (Missiles and Rockets, 31 October, 1960, p. 31.)

157. FUTURE NEEDS OF SEA POWER. J. S. McCain, Jr. (National Research Council, Committee on Undersea Warfare, Washington, D. C., Serial No. NRC:CUW:0155, 1952, 3 p.) AD-4958

This paper was presented at the 7th Undersea Symposium, Washington, D. C., 15-16 May 1952, SECRET.

158. SUBMARINE TACTICAL GAMES. J. M. Newton, F. J. Wuest and A. E. Hickey, Jr., Electric Boat Division, General Dynamics Corporation. (Naval Research, June 1959, pp. 14-17)

War gaming has had a long and honorable military and naval career since the Prussians first developed the technique from "military chess" 300 years ago. In the United States, development of war games for the Navy's use has been pursued primarily at the Naval War College. There, many advances have been made in the comprehensive display of situation information to the participants, ranging from large game boards many hundreds of feet in area to the combined projection and plotting screen of the new Navy Electronic Warfare Simulator (NEWS). Until recently in the conduct of war games, the outcome of any interaction between forces, such as detection and gunfire, has been decided by umpires. Their on-the-spot decisions were based on expert opinion, usually aided by graphs, probability tables, or a roll of the dice. In the NEWS facility, this procedure has been formalized, and some of the decisions about uncertain events are made automatically, based on empirically derived statistics programmed into a computer before the game begins.

159. DEPARTMENT OF DEFENSE REQUIREMENTS AND INVENTORY ANALYSIS. (North American Aviation, Inc., Los Angeles Division, Pub. 515-X-1, October 1959, SECRET/Limited Circulation)

Contents include: Submarine systems; Defense systems, overall. Space programs; Lunar studies; VTOL (Model); Propulsion, space; SAC (Model); TAC (Model); Weapon systems, future; Disarmament, world; Radar, early warning.

160. CATCHING UP WITH THE SUBMARINE. P. Cohen. (Space/Aeronautics, Vol. 33, January 1960, pp. 48-50)

161. SUBMARINE HYDRAULICS PRIMARY NEED: GREATER SHARE OF R & D FUNDS. William O. Foss. (Underwater Engineering, Vol. 2, No. 1, January 1961, pp. 21-22)

The control surfaces, ballasting controls, propulsion plant valves and nearly all the important fighting equipment of a submarine is powered hydraulically. Snorkel mast, periscopes, communications antennas, capstans, winches, windlasses, missile handling and launching devices are operated from the hydraulic systems.

Practical application of hydraulics on a submarine is dependent upon the principle of Pascal's law, which states that "pressure on any part of a confined liquid is transmitted undiminished in all directions throughout the liquid."

The hydraulic system -- often called the heart, the arteries, and muscle power of the submarine -- needs more work to reduce structural and fluid borne noise generated by it. To do this Navy requires more research and development money, something which has been sadly lacking in past years.

162. THE SUBMARINE APPROACH PROBLEM. Earl Crisler and Melbourne Stewart. (University of Michigan, Engineering Research Institute, Ann Arbor, Contract N6onr-232, T. O. 1, Report No. M720-1 R37, December 1952, 27 p.) AD-5767

SECTION A

Submarines

5. General Articles on Submarines

b. History and Bibliographies

163. UNDERSEA WARFARE. A REPORT BIBLIOGRAPHY. (Armed Services Technical Information Agency, Arlington, Va., 1 October 1961, 1084 p. UNCLASSIFIED) AD-264 000

This bibliography was prepared by ASTIA in response to frequent requests for information concerning Undersea Warfare and related topics. A confidential and secret section of the bibliography appear separately as AD-325 700 and AD-324 701 respectively. Citations are included for documents cataloged by ASTIA from 1953 through 1 October 1961. Entries are arranged in alphabetical sequence by subject areas pertaining to problems in detection, navigation, ordnance propulsion, and underwater sound. Within each category, and its subdivisions, reports published by Department of Defense contractors are listed alphabetically by source and contract number, and then by date; military reports are arranged by source and title.

164. UNDERSEA WARFARE. A REPORT BIBLIOGRAPHY (U). (Armed Services Technical Information Agency, Arlington, Va., 1 October 1961, 1911 p., CONFIDENTIAL) AD-325 700

This bibliography was prepared by ASTIA in response to frequent requests for information concerning Undersea Warfare and related topics. An unclassified and secret section of the bibliography appear separately as AD-264000 and AD-325 701 respectively. Citations are included for documents cataloged by ASTIA from 1953 through 1 October 1961. Entries are arranged in alphabetical sequence by subject areas pertaining to problems in detection, navigation, ordnance, propulsion, and underwater sound. Within each category, and its subdivisions, reports published by Department of Defense contractors are listed alphabetically by source and contract number, and then by date; military reports are arranged by source and title.

165. UNDERSEA WARFARE. A REPORT BIBLIOGRAPHY (U). (Armed Services Technical Information Agency, Arlington, Va., 1 October 1961, 312 p., SECRET) AD-325 701

This bibliography was prepared by ASTIA in response to frequent requests for information concerning Undersea Warfare and related topics. An unclassified and confidential section of the bibliography appear separately as AD-264 000 and AD-325 700 respectively. Citations are included for documents cataloged by ASTIA from 1953 through 1 October 1961. Entries are arranged in alphabetical sequence by subject areas pertaining to problems in detection, navigation, ordnance, propulsion, and underwater sound. Within each category, and its subdivisions, reports published by Department of Defense contractors are listed alphabetically by source and contract number, and then by date; military reports are arranged by source and title.

166. SUBMARINE DEVELOPMENT PRIOR TO WORLD WAR I. E. M. Avalone. (American Society of Naval Engineers, Journal, Vol. 72, No. 2, May 1960, pp. 277-283)

First submarine attack in 1776, and designs evolved in 1578 and 1624, are mentioned, and further design history and use of submarine in warfare outlined; profile diagrams of some types constructed up to about 1900 are included.

167. JFK ASKS FOR 1600 MISSILES. Charles W. Corddry. (Los Angeles Herald-Examiner, Thursday, 18 January 1962) (p. A-14)

The president said he was significantly increasing Polaris submarines, Minutemen missiles and other strategic forces to assure that America could survive any attack "and strike back decisively". He said his assurance was based on "exhaustive analysis" of Russian military forces.

For the more likely threat of limited aggression, he said, he was "substantially" strengthening conventional forces so the nation would not have to choose between "nuclear holocaust or retreat."

168. ROYAL NAVY'S FREAK SUBMARINE DESIGNS. R.S. Higham. (American Society of Naval Engineers, Journal, Vol. 71, No. 1, February 1959, pp. 63-69)

Information on various submarines in K, X-1 and M classes, built during period 1915-1932; units, for which performance data is included, range from steam driven type to M-2 modified for carrying aircraft.

169. AN ANNOTATED LITERATURE SURVEY OF SUBMARINES, TORPEDOES, ANTI-SUBMARINE WARFARE, UNDERSEA WEAPON SYSTEMS, AND OCEANOGRAPHY: 1941 TO JANUARY 1962. Barbara Ann Bryce. (Autonetics, a division of North American Aviation, Inc., Report No. EM-GA101, 3 March 1962, 533 references.)

This report is divided according to subject and alphabetized within each category by source, author, date, and page. Complete author, source and subject indexes conclude the 485 references and 48 unindexed addenda. The subjects are broken down accordingly: I.) Submarines; a.) Control Systems; b.) Study of Submarine Noise; c.) Model Tests and Sea Trials; d.) Analytical Studies of Stability and Control Investigations; e.) General articles on submarines: 1) Marketing; 2) History and Bibliographies; 3) Fleet Rehabilitation and Modernization; 4) Foreign Progress and Past Events; 5) Optical and other equipment in/for Submarines; 6) Nuclear Submarines. II.) Torpedoes; III.) ASW (Antisubmarine Warfare) and UWS (Undersea weapons systems); and IV.) Oceanography, the primary purpose of which is to learn of oceanographic instrumentation.

170. AN ANNOTATED BIBLIOGRAPHY OF SUBMARINE TECHNICAL LITERATURE, 1557 TO 1953. (Committee on Undersea Warfare, National Research Council, Washington, D.C., Contract N7onr-29103, Pub. No. 307, March 1954, 261 p.) AD-49 957

171. RECENT SUBMARINE DESIGN PRACTICES AND PROBLEMS. A.I. McKee. (Society of Naval Architects & Marine Engineers, Paper No. 11 for meeting November 12-13 1959, 14 p.)

Submarines of United States in use during World War II, changes made during war, and comparisons with German submarines; displacement, weight, stability and some machinery problems peculiar to submarines, and effect of nuclear power on these and on external shape, compartmentation and air conditioning; configurations of structure of pressure hull which have been use or proposed; avenues available for strengthening pressure hull to obtain greater operating depth.

172. THE STORY OF THE HOLLAND SUBMARINE. Richard Knowles Morris, Trinity College, Hartford, Connecticut. (United States Naval Institute Proceedings, Vol. 86, No. 1, January 1960, pp. 78-89)

The story of the SS-1 HOLLAND is the story of the birth of the submarine fleet of the U. S. Navy.

173. THE SUBMARINE. (U.S. Navy, NAVPERS, Report No. 16160-A, May 1955, UNCLASSIFIED)

Contents include: NAUTILUS (Model); ALBACORE (Model); SNORKEL (Model); Submarine systems; Submarines - Design.

174. AN ANTISUBMARINE WARFARE BIBLIOGRAPHY (U). Lloyd J. Jackson. (U.S. Navy, NAVORD, Report No. R-6426, 19 November 1958, CONFIDENTIAL.)

Contents include: c.r. NAVY N.O.T.S. TP-2132; Bibliographies; ASW (Model); Submarines -- Detection; Submarines -- Fire Control Systems.

SECTION A

Submarines

5. General Articles on Submarines

c. Fleet Rehabilitation and Modernization

175. SUBMARINE FRAM PROGRAM, WHAT AND WHY. L. L. Jackson, Jr., and J. M. Roach. (American Society of Naval Engineers, Journal, Vol. 72, No. 2, May 1960, pp. 211-220)

Explanation of Fleet Rehabilitation and Modernization (FRAM) Program, and application to rehabilitation of USS Tiru from planning through work stages, which called for 15 major items; modernization provides plastic fairwater for redesigned conning tower, lengthened hull, etc; advantages, gained for Tiru by investment of less than three times cost of regular overhaul, are being obtained for selected number of United States destroyers and submarines.

176. RESISTANCE EXPERIMENTS ON A SYSTEMATIC SERIES OF STREAMLINED BODIES OF REVOLUTION -- FOR APPLICATION TO THE DESIGN OF HIGH-SPEED SUBMARINES. (David Taylor Model Basin, Report No. C-297, April 1950, CONFIDENTIAL)

Contents include: Submarines - Design; Bodies of revolution.

177. INSTITUTION OF NAVAL ARCHITECTS. (Engineer, Vol. 207, No. 5384, 3 April 1959, pp. 532-533; No. 5385, 10 April 1959, pp. 577-579; No. 5386, 17 April 1959, pp. 620-622, No. 5387, 24 April 1959, p. 661; No. 5388, 1 May 1959, pp. 693-695)

Review of papers and discussions at Spring Meeting, London, opened March 24 1959.

178. U. S. SUBMARINES: ILLUSTRATIONS WITH TEXT. (Engineer, Vol. 209, 8 January 1960, p. 77)

179. SUBMARINES VS SUBMARINES. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-249400, May 1960, CONFIDENTIAL) AD-317 511

180. PROPOSAL FOR A COORDINATED SUBMARINE-ELECTRONICS DESIGN PROGRAM. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Report No. R-61-A-03, 8 January 1961, CONFIDENTIAL)

181. CLASSIFIED TITLE. (General Electric Company, Pittsfield, Mass., Contract NObs-72 302, Final Development Report, Report No. R57APS122, 1 July-31 October 1957, CONFIDENTIAL) AD-154 769

Feasibility and Design Study.

182. AEROELASTIC STABILITY OF LIFTING SURFACES IN HIGH-DENSITY FLUIDS. C. J. Henry, J. Dugundji, and H. Ashley. (Journal of Ship Research, Vol. 2, No. 4, March 1959, pp. 10-21)

It is noted that ships mounting elastically restrained lifting surfaces such as rudders, fins, hydrofoils and bow planes experience pressures greater than for any but fastest aircraft, yet similar instabilities are rare; analysis is prompted by extraordinary speeds to be reached by submarines and other vehicles towed or propelled beneath surface; recommendations are made to allow for channel boundaries, free surfaces, cavitation or separated flow in analyses.

183. NEW CONCEPTS IN DESIGN OF NAVAL SHIPS. (Marine Engineering, Vol. 64, No. 2, February 1959, pp. 67-69)

Approach to consideration of ideas adopted by Bureau of Ships, which has resulted in startling new concepts in ship design; new concepts are indicated by notes on nuclear aircraft carrier Enterprise, nuclear and missile submarines, new submarine applications such as submersible landing ship, seaplane tender, amphibious assault systems, replacement ship, and task force defense ships.

184. POLARIS BASES: PACIFIC DIVISION. (News Item from Missiles and Rockets, 24 July 1961, p. 9)

POLARIS submarines operating in the Pacific will load their missiles at Pearl Harbor and undergo overhaul at Puget Sound, Wash. The POLARIS depot at Pearl Harbor will be similar to the one near Charleston, South Carolina. The Navy long-range plans call for deploying two POLARIS squadrons—18 submarines—in the Pacific.

185. POLARIS SUBS: NO. 20 THROUGH 29. (News Item from Missiles and Rockets, 24 July 1961, p. 9)

The Navy is understood to be ready to let contracts for construction of all 10 of the latest POLARIS submarines planned by the Administration as soon as Congress passes the FY '62 appropriations bill. The submarines will bring to 29 the total number in the POLARIS fleet commissioned or building. Latest price tag on a Polaris sub: $116.2 million—about $78 million for the submarine and $38 million for POLARIS system equipment.

186. FIFTH NAVY SCIENCE SYMPOSIUM. NAVAL RESEARCH. SPONSORED BY THE OFFICE OF NAVAL RESEARCH, APRIL 18, 19, 20, 1961, U. S. NAVAL ACADEMY, ANNAPOLIS, MARYLAND. (Office of Naval Research, Washington, D. C., Report No. ONR-9, Volume 1, 1961, 367 p.) AD-260 239

Descriptors: Probability, Guided Missiles, *Digital Computers, Thermoelectricity, Materials, Aerodynamic heating, Spaceships, Radiation damage, chemical analysis, De-icing materials, De-icing systems, Optical materials, Infrared spectroscopy, *Solid state physics, Dosimeters, molecular structure, Crystals, Polymers, Free radicals, *Symposia, *Scientific research, *Naval research, Niobium, Alloys, Magnetic properties, Radiation effects, Ferrites, Particles, Infrared research, Mathematics, Mathematical analysis.

187. FIFTH NAVY SCIENCE SYMPOSIUM. NAVAL RESEARCH. SPONSORED BY THE OFFICE OF NAVAL RESEARCH, APRIL 18, 19, 20, 1961, U. S. NAVAL ACADEMY, ANNAPOLIS, MARYLAND. (Office of Naval Research, Washington, D. C., Report No. ONR-9, Vol. 2, 1961, 406 p., 151 refs.) AD-260 240

Descriptors: *Symposia, *Naval research, *Scientific research, Blood, Contamination, Oxygen equipment, atmosphere models, Body temperature, Man, Thermoelectricity, Thermionic emission, Protosn, Dossage, Power supplies, Hydrodynamics, High temperature research, Pions, Polymers, Molecular structure, Decomposition, Reactor coolants, Hydrides, Vinyl radicals, Aluminum, Personnel, Selection, Behavior, Training, Job analysis, Auditory acuity, Training devices, Teaching machines, Tracking, Leadership, Toxicity.

188. FIFTH NAVY SCIENCE SYMPOSIUM. NAVAL RESEARCH. SPONSORED BY THE OFFICE OF NAVAL RESEARCH, APRIL 18, 19, 20, 1961, U. S. NAVAL ACADEMY, ANNAPOLIS, MARYLAND. (Office of Naval Research, Washington, D. C., Report No. ONR-9, Vol. 3, 1961, 402 p., 174 refs.) AD-260 241

Descriptors: Solid state physics, Electron beams, *Symposia, Radio waves, Meteorological radio, Ducts, Oceans, Meteorological instruments, Measurements, Thin-films, Electronic equipment, Electronic circuits, Photoconductivity, Infrared detectors, Water waves, Ships, Submarines, Hydrofoils, *Oceanography, Ferroelectric materials, Ceramic materials, Barium compounds, Titanates, Naval ordnance, Antisubmarine warfare, Cathode ray tubes, Polarographic analysis, Upper atmosphere, *Naval research, *Military research, *Scientific research, Guns, Propellants, Mathematical analysis, Hydrodynamics, Beaches, Hydrology, Acoustics, Marine biological noise.

189. METHODS OF SUBMARINE BUOYANCY CONTROL. (Office of Scientific Research and Development, Contract OEMsr-1131, Summary Technical Report, Vol. 6B, 1946, 89 p., 49 refs.) PB 139 776

190. CLASSIFIED TITLE. P. Cohen, V. Lowen, and B. Owens. (Sperry Gyroscope Co., Great Neck, New York, Contract NOrd-16040, Sperry Report No. 5285-7315, Interim Report No. 22, October 1957, 23 p., NAVORD Report No. 4716, CONFIDENTIAL) AD-158 643

191. THE SUBMARINE. (Standards and Curriculum Branch, Training Div., Bureau of Naval Personnel, NavPers 16160-A, Revised May 1955.)

192. INTERACTION OF A MOVING SUBMERGED BODY AND AN INITIALLY UNDISTURBED FREE WATER SURFACE. (Stevens Institute of Technology, Report No. R-391, October 1949, CONFIDENTIAL)

Contents include: Submarines -- Motion; Submarines -- Control; Submarines -- Testing.

193. TESTS OF SUBMARINE MODEL TO DETERMINE FORCES ASSOCIATED WITH PROXIMITY TO SURFACE. (Stevens Institute of Technology, Report No. R-392, December 1949, CONFIDENTIAL)

Contents include: Submarines -- Testing; Submarines -- Motion; Submarines -- Control.

194. COMMITTEE REPORTS FOR THE SPECIAL PROJECTS OFFICE STEERING TASK GROUP MEETING. (U.S. Navy, Navy Special Projects Office, Report No. R-61-A-12/13, 12-13 January 1961, SECRET/Restricted Data)

Contents include: POLARIS (Model); Submarines -- Command systems; Submarines -- Propulsion; Navigation systems, submarine.

195. A REPORT ON THE PCCS (FALL, 1960) EFFECTIVENESS STUDY. (U.S. Navy, Navy Underwater Sound Lab., Report No. RR-489, 24 October 19 60, SECRET)

Contents include: POLARIS (Model); Submarines -- Command systems; Submarines -- Communication systems.

196. POLARIS SUB TENDER PROTEUS HAS UNDERGONE MASSIVE CONVERSION. (News Item from Underwater Engineering, Vol. 2, No. 1, January 1961, p. 18)

POLARIS sub tender PROTEUS has undergone massive conversion and is now 44 ft longer than before. The ship is capable of any repair or replacement—short of complete overhaul—for a fleet of POLARIS subs. Unique features of the tender include a giant bridge crane to handle the IRBM, and four deck storage area for 20 missiles, a 120-ton container to store nuclear waste and a $5 million navigational system repair center.

SECTION A

Submarines

5. General Articles on Submarines

d. Foreign Progress and Past Events

197. SUBMARINERS KEEP THEIR WORD. (Bloknot Agitatora (The Agitators Notebook), No. 18, June 1961, pp. 9-10)

198. SUBMARINE WENT OUT TO SEA; FROM THE DIARY OF A PROPAGANDIST. N. Lemeshchenko. (Bloknot Agitatora (The Agitators Notebook), No. 20, July 1961, pp. 28-31)

199. MARINE ENGINEERING NOTES FROM SOVIET PRESS. B. M. Kassell. (American Society of Naval Engineers Journal, Vol. 70, No. 4, November 1958, pp. 619-628)

References to conversion of Soviet submarine into underwater laboratory; raising of cargo ship Lepsye, and use of longitudinal slipway for repair work; hydrofoil motor ship Raketa; diesel engine manufacture; propeller failures; building at various shipyards, etc.

200. ROYAL NAVY—1958. (Engineer, Vol. 207, No. 5371, 2 January 1959, pp. 4-8; Vol. 207, No. 5372, 9 January 1959, pp. 46-48)

Navy's role in global war; numbers and types of H. M. ships; submarine and antisubmarine situation; dockyards and maintenance.

201. NAVAL CONSTRUCTION IN 1958. R. V. B. Blackman. (Engineer, Vol. 207, No. 5373, 16 January 1959, pp. 88-93)

Illustrated descriptions of new frigates, submarines, patrol boats, etc., in Great Britain, United States, and other countries.

202. MARINE NUCLEAR. (Engineering, Vol. 187, No. 4859, 24 April 1959, pp. 545-548)

Problems of shielding and safety in conjunction with nuclear ship propulsion; transfer from United States to United Kingdom of complete Skipjack-type submarine nuclear propulsion plant; British project; gas cooled ship reactor; other projects.

203. MAN UNDERWATER. CHELOVEK POD VODOI. V. G. Fadeev, A. A. Pechatin and V. D. Surovikin. (Izd. 2., Ispr. i Dop., Moskva, Izd-vo DOSAAF, 1960, 263 p.)

204. SOME RECENT PROGRESS IN NUCLEAR ENGINEERING. J. Cockcroft. (Joint Panel on Nuclear Marine Propulsion Journal, Vol. 3, No. 1, April 1959, pp. 1-9)

Discussion of reactor types which may have application to marine engineering, taking into account capital and operating costs as well as performance; reactors considered are pressurized and boiling water types, advanced gas cooled, and organic liquid moderated types; reference is made to actual and proposed ship and submarine installations; remarks on safety, and on United Kingdom nuclear propulsion program. Parsons Memorial Lecture, 1958.

205. SOME UNUSUAL OPERATIONS ON PARTS FOR NUCLEAR-POWERED SUBMARINES. (Machinery, British, 6 September 1961, pp. 567-571)

206. MARINE PROPULSION PROJECTS. (Nuclear Engineering, Vol. 4, No. 38, May 1959, pp. 193-196)

Exploits of Nautilus and Skate demonstrated practicability of nuclear propulsion for marine application; world review of projects building and planned; British nuclear submarine Dreadnaught; French nuclear submarine Q244; Russian nuclear icebreaker Lenin; American nuclear submarines Nautilus, Seawolf, Skipjack, Skate, and nuclear merchant vessel Savannah; studies in Denmark, France, Germany, Holland, Italy, Japan, Norway and Sweden.

207. NUCLEAR POWERED SHIPS. K. Maddocks. (Nuclear Power, Vol. 3, No. 31, November 1958, pp. 535-540; Vol. 3, No. 32, December 1958, pp. 588-591)

November: Reactor data for nuclear powered ships; Russian icebreaker Lenin develops 44,000 hp from three PWR; American passenger-cargo vessel Savannah develops 22,000 hp from single 74 mw PWR; French interest in 20,000 hp vessel includes three studies which cover PWR system, 51 mw boiling water reactor, and 60 mw CO_2 cooled graphite moderated reactor. December: British interest in 30,000 to 50,000 hp vessel powered by gas cooled graphite or heavy water moderated reactor; Japanese design of 180 mw PWR for 26,000 ton passenger ship, PWR for submarine oil tanker; developments regarding shielding techniques, reactor design, and heat exchangers.

208. O PREOBRAZOVANII MEKHANICHESKOI ENERGII V ENERGIYU SVCHEKOLEBANII I O SBCH-MOTRE. N. G. Basov. (Radiotekhnika i Elektronika, Vol. 4, No. 7, July 1959, pp. 1180-1184)

Conversion of mechanical energy into microwave oscillations; microwave motor; problem of separation of paramagnetic ions in alternating magnetic fields; examples of devices using such separation systems.

209. BRITISH NUCLEAR SUBMARINE "DREADNOUGHT". (Shipbuilding & Shipping Record, Vol. 96, No. 17, 27 October 1960, pp. 541-542)

Notes on vessel launched at Vickers-Armstrongs yard; length 226 ft, beam 32 ft, surface displacement about 3500 tons; pressurized water reactor of type fitted in USS Skipjack will be used to drive single shaft through steam turbines; cutaway drawing shows general arrangement.

210. 404 DAYS! THE WAR PATROL LIFE OF THE GERMAN U-505. Hans Joachim Decker, Museum of Science and Industry, Chicago. (United States Naval Institute Proceedings, Vol. 86, No. 3, March 1960, pp. 33-45)

Since 1954 the steps of some two million visitors have clanged on the deck, ladders, and passageways of a 250-foot monster "moored" at Chicago's Museum of Science & Industry.

What contributions to the German war effort had the U-505 made? Her career was unique, and yet the pattern of her operations was typical of most U-boats.

211. LAST CHAPTER FOR U-853. D. M. Tollaksen, U. S. Navy. (U. S. Naval Institute Proceedings, Vol. 86, No. 12, pp. 82-89)

A sunken Nazi U-boat in 20 fathoms of water a few miles south of Newport has aroused keen interest in skin-diving circles in Rhode Island. The story of that kill is the subject of this article.

Note: For Hydrofoils see Journal of Ship Research, 1958, 1959, 1960, 1961.

212. JAPANESE SUBMARINE TACTICS. Kennosuke Torisu and Masataka Chihaya, Graduates of the Japanese Naval Academy and former Commanders in the Imperial Japanese Navy. (United States Naval Institute Proceedings, Vol. 87, No. 2, February 1961, pp. 78-83)

One of the most interesting, unanswered questions having to do with Japanese submarine operations in World War II concerns the sinking of the cruiser USS INDIANAPOLIS by I-58. How did it happen that the submarine found herself in such an advantageous position on 29 July 1945?

SECTION A

Submarines

5. General Articles on Submarines

e. Optical and Other Equipment in/for Submarines

213. ANALYSIS AND INVESTIGATION OF PROPELLER BLADE STRESSES. PART I. E. Venning and T. E. Reynolds. (David Taylor Model Basin, Washington, D. C., Report No. 1531, June 1961, 32 p., 19 refs.) AD-259 944

Failures in service of wide bladed marine propellers indicate that the design stage stress analysis may have engendered a false sense of security in the propeller's strength. The Taylor method of stress analysi is accordingly examined and compared with a newly developed shell theory of stress analysis. The results of certain photoelastic experimental work are also reported as verifying that actual stress distributions in propellers are different from those predicted by the Taylor method.

214. HOW MILITARY SEES IN DARK. (Electronics, Vol. 32, No. 26, 26 June 1959, p. 20+)

Low-light-level television furnishes eyes for nuclear submarines and space vehicles. Also used in radio astronomy and special fire-control.

215. HOW RADIATION MONITOR GUARDS NUCLEAR NAVY. H. E. DeBolt. (Electronics, Vol. 33, 22 January 1960, pp. 43-45)

216. SONAR GUIDES SUBMARINES UNDER POLAR ICE. L. H. Dulberger. (Electronics, Vol. 34, 24 March 1961, pp. 18-19)

217. ATOMIC SUBMARINES DEPEND ON AIR CONDITIONING. (Heating-Piping, Vol. 31, November 1959, pp. 40-41)

218. AIR CONDITIONING VITAL TO ATOMIC SUB CRUISING. J. H. Ebersole. (Heating-Piping, Vol. 32, August 1960, p. 109)

219. UNDERWATER COMMUNICATION SYSTEM. N. D. Miller. (IRE Transactions on Communications Systems, Vol. CS-7, No. 4, December 1959, pp. 249-251)

Communications between submerged submarines and surface craft require energy to be propagated through sea water; only practical method for transmitting this energy is by acoustic means; for long-range communication, single-sideband suppressed-carrier transmission system is only effective way of propagating this sound energy; requirements of transmission system.

220. DATA RECORDING AND PROCESSING REQUIREMENTS - WEAPON SYSTEM TEST SSB(N)-608 CLASS SHIPS. (Johns Hopkins University, Report No. STD-2, No Date, CONFIDENTIAL)

Contents include: Data Processing; Recording, Data; FBM (Model); Submarines- Testing; Weapon Systems - Testing.

221. STRANGE "FISH" UNDER THE POLAR ICE! (Missile Design & Development, September 1960, pp. 36-37)

Aboard the nuclear submarine "Sea Dragon", the first undersea magnetic video tape recorder will record and store data on under-the-ice characteristics from externally installed TV cameras. Upon return to base the recorded information will be displayed for the benefit of undersea service trainees, greatly increasing their understanding of hazardous polar navigation techniques. The recorder, a joint U.S. Navy-RCA effort, is a marvel of compact design (Dimensions: 20" x 20" x 100"). It nestles securely in the limited confines of a torpedo rack, yet represents a 60 per cent space reduction over existing commercial video tape equipment. Designed to the curvature of the torpedo rack it will fit through the opening of a 24-inch hatch. Though small in size, the 4 megacycle recording it produces is fully compatible with its commercial counterpart!

222. NEW SUB DEPTH GAGE DEVELOPED. (News Item from Missiles and Rockets, 24 July 1961, p. 21)

A 3-5 times increase in measuring accuracy has been achieved with a new submarine depth gage developed by Westinghouse, the company reports. Capable of operating at depths five times greater than ever before, the new gage employs electrical measurement rather than mechanical (Bourdon tube) measurement used in conventional gages. Readout is by numerical meter instead of indicator dial.

223. DEVICE SEEN VASTLY IMPROVING ACCURACY OF SUBMARINES' POSITION FIXING. (Missiles and Rockets, Vol. 9, No. 5, 31 July 1961, pp. 36-38)

Koolsman scientists says use of modified aircraft tracker can yield order-of-magnitude advances; details of system.

224. HYDRA PROGRAM. UNDERWATER EXPLOSION BUBBLE'S TIME HISTORY. M. Kaltwasser. (Naval Radiological Defense Laboratory, San Francisco, Report No. NRDL-TR-513, 2 June 1961, 21 p.) AD-260 391

A brief description of the physical phenomena - gas bubble, shock wave, and water flow - arising from an underwater spherical chemical detonation, along with a critique of past work on the subject is presented. Assuming a non-steady, irrotational, compressible, unbounded water flow in a zero gravitational field, and using appropriate fluid dynamic and certain assumed thermodynamic relations, the exact equation for the water potential function F is derived. The general solution, F(r, t), is discussed, and two particular solutions, with boundary conditions applied, are presented for the bubble radius a(t) up to the time of first maximum radius.

225. BALANCING ROTATING MACHINERY. S. Elonka. (Power, Vol. 103, No. 6, June 1959, pp. 213-236)

Detection of vibration in early stages can prevent damage; nonsymmetrical weight distribution is basic cause of unbalance, which contributes to vibration; analysis and measurement of vibration requires understanding of amplitude, frequency, resonance, critical speed, harmonics, etc; application of machines for detecting amount and location of unbalance; fundamentals of field testing in troubleshooting of unbalance and vibration.

226. THERMOELECTRIC AIR CONDITIONER FOR SUBMARINES. J. R. Andersen. (RCA Review, Vol. 22, June 1961, pp. 292-304)

227. COSTA PROPULSION BULB. O. Greger. (Shipbuilding & Shipping Record, Vol. 93, No. 3, 15 January 1959, pp. 73-76)

Information on development and application of device for recovering energy from losses behind propeller; it comprises streamlined body which is welded to rudder immediately abaft propeller boss, having its center line continuous with center line of shaft; bulb eliminates vortices which trail from propeller boss, tranquilizes flow of water behind propeller, prevents its sudden contraction and smoothes wake.

228. PROVIDING BETTER AIR FOR BOTTLED UP MEN IN A NUCLEAR SUBMARINE. E. A. Ramskill. (SAE Journal, Vol. 69, June 1961, pp. 80-81)

229. DIGITAL-ANALOG HARDWARE SIMULATION BACKS UP POLARIS DESIGN. C. H. Kaufmann, Lockheed Missiles & Space Co., Guidance & Simulation, Research Laboratories, Sunnyvale, California. (Space/Aeronautics, September 1961, pp. 67-70)

The Polaris simulation program is made up of six-degree-of-freedom trajectory routines, programed for a digital computer and equivalent mathematical models applied to an analog computer and actual hardware. On the basis of digital computer simulation, guidance accuracy is evaluated, while the analog-hardware setup simulated actual flight control and guidance system components. The trajectory computer program includes the effects of submarine motion and sea-state parameters on the early phases of the missile's flight.

With the help of the simulation program, design studies are verified, interface and design deficiencies are spotted in advance of flight testing, and malfunctions in actual flight tests are diagnosed.

230. EQUIPMENT SPECIFICATION NO. 2264-103A NAVDAC SELECTOR SWITCHBOARD NAVIGATION SUBSYSTEM FOR SSB(N) 608 CLASS. (Sperry Gyro. Co., Report No. GA-13-0002-3A, January 1960, UNCLASSIFIED)

Contents include: Navigation subsystems, fleet ballistic; FBM (Model); NAVDAC (Model); Submarine systems; Selectors - Switchboard.

231. SINS MK 2 MOD 0 MAINTENANCE EQUIPMENT DRAWINGS AND SCHEMATICS. (U. S. Navy, NAVSHIPS Report No. 324-0437, Vol. VIII, April 1960, CONFIDENTIAL)

Contents include: SINS (Model); Submarines, FBM; Navigators, Inertial.

232. WELDING OF TRITON, WORLD'S LARGEST NUCLEAR-POWERED SUBMARINE. G. W. Kirkley, Jr. (Welding Journal, Vol. 39, No. 9, September 1960, pp. 893-902)

Operations described range from heavy multipass welds on hull plating to minimum size deposits on small diameter reactor instrumentation tubing; hull is of 100% welded construction; fabrication of nuclear piping systems; special method for bimetallic welding developed to meet stringent service requirements.

233. WELDING HELPS LAUNCH FIRST NUCLEAR-POWERED MERCHANT SHIP. (Welding Engineer, Vol. 44, No. 9, September 1959, pp. 50-51)

N. S. Savannah which can carry crew of 110 and about 10,000 tons of dry cargo at cruising speed of 21 knots, can travel estimated 300,000 nautical miles in 3.5 yr without refueling; reactor is same as in Nautilus and Skate; two hemispherical heads and center section of reactor containment vessel were fabricated separately with E-7016 low hydrogen electrodes.

SECTION A

__Submarines__

5. General Articles on Submarines

f. Nuclear Submarines

234. THUNDER ON THE CLYDE (OPPOSITION TO POLARIS SUBMARINE BASE AT HOLY LOCH). (Economist, Vol. 197, 5 November 1960, p. 532.)

235. LIVING WITH POLARIS (HOLY LOCH SUBMARINE BASE PROBLEMS). (Economist, Vol. 197, 5 November 1960, pp. 531-532.)

236. POLARIS MISSILE TRAINER. (Franklin Institute Journal, Vol. 270, October 1960, p. 338)

237. THE MISSION OF THE POLARIS WEAPON SYSTEM. (General Electric, Report No. DC-18701, No Date, SECRET)

Contents include: POLARIS (Model); Submarine systems.

238. CHARACTERISTICS AND PERFORMANCE OF NUCLEAR-POWERED SUBMARINE CARGO VESSELS. J. A. Teasdale. (International Shipbuilding Progress, Vol. 7, No. 70, June 1960, pp. 253-256)

Indexed in Engineering Index 1959, p. 1380 from North East Coast Institution of Engineers & Shipbuilders—Transactions May-June 1959.

239. PLANNING AND SCHEDULING SSB(N)-608 CLASS SHIPS. (Johns Hopkins University, Report No. STD-3, No Date, CONFIDENTIAL)

Contents include: FBM (Model); Submarines - Fire Control Systems; Submarines - Testing; POLARIS (Plans and Planning) (Model)

240. MACHINE SHOP BEHIND OUR ATOMIC SUBMARINES. Harold W. Bredin, assoc. ed. (Machinery, June 1961, pp. 98-105)

Geared for the ultimate in short-run production, Electric Boat Division's machine shop turns out more than its share of unique and contoured parts. An apprentice training program keeps the shop well supplied with highly skilled mechanics.

241. ABE LINCOLN LAUNCHES FIVE OF AN AFTERNOON. (News Item from Missiles and Rockets, 29 May 1961, p. 11)

The nuclear-powered submarine Abraham Lincoln, operating under DOD-imposed secrecy, is understood to have launched five operational POLARISES down the Atlantic Missile Range in one afternoon earlier this month. She is understood to have sailed with a full load of 16. According to a Cape report, holds prevented the planned launching of more birds the same day. But the report is unconfirmed.

242. FRENCH FBM IN '69? (News Item from Missiles and Rockets, 5 June 1961, p. 9)

A nuclear-powered submarine program will reach the building stage during 1963 in France. The three subs in the program, however, aren't expected to be ready for testing until 1967 or to become operational with a POLARIS-type missile until 1969.

243. POLARIS MOVES TO THE MED. (News Item from Missiles and Rockets, 5 June 1961, p. 9)

Whether or not NATO accepts President Kennedy's offer of five POLARIS submarines, the second squadron of U. S. missile-launching submarines probably will operate in and out of the Mediterranean Sea. The second POLARIS tender, the Hunley, is expected to seek a southern European anchorage either in the Mediterranean or possibly somewhere on the coast of Portugal.

244. POLARISKI SUBS WERE MISSING. (News Item from Missiles and Rockets, 7 August 1961, p. 9)

Western observers especially observed that the Russians did not produce any missile-launching nuclear-powered submarines at the recent Red Navy show at Leningrad. The Soviets have boasted that they now have more of them than the United States. The failure of at least one of the subs to make an appearance increased the belief of U. S. officials that the best the Soviets have so far is a nuclear-powered sub capable of launching only short range missiles.

245. NUCLEAR POWER FOR PROPULSION OF COMMERCIAL SHIPPING. J. Cockcroft. (North East Coast Institution of Engineers & Shipbuilders Transactions, Vol. 75, Pt. 1, November 1958, pp. 27-38; also, International Shipbuilding Progress, Vol. 5, No. 51, November 1958, pp. 515-521; Engineer, Vol. 206, No. 5363, 7 November 1958, pp. 729-731; Shipbuilder & Marine Engine-Builder, Vol. 65, No. 610, December 1958, pp. 666-669)

Present state of development in light of technical performance of nuclear submarines of United States, and information disclosed at Geneva Conference on development of commercial nuclear propulsion; application of pressurized water and boiling water reactors; economic factors; safety of nuclear propulsion. 27th Andrew Laing Lecture.

246. CHARACTERISTICS AND PERFORMANCE OF NUCLEAR-POWERED SUBMARINE CARGO VESSELS. J. A. Teasdale. (North East Coast Institution of Engineers & Shipbuilders Transactions, Vol. 75, Pt. 7, May-June 1959, pp. 461-472)

Likely characteristics and performance of submarine tanker and comparison with surface tanker, both of 47,000 ton dw, with nuclear propulsion and powers to 40,000 shp; at normal speeds optimum submarine form would have slightly lower resistance than surface vessel but margin is such that saving in annual fuel bill is unlikely to offset additional cost of submarine and operational difficulties.

247. THE DEVELOPMENT OF NUCLEAR PROPULSION IN THE NAVY. Carl O. Holmquist, U. S. Navy, and Russell S. Greenbaum. (United States Naval Institute Proceedings, Vol. 86, No. 9, September 1960, pp. 65-71)

In February of this year, the nuclear submarine SARGO became the third U. S. Navy submarine to cruise under the polar ice cap. Furthermore, SARGO was the first submarine to break through the ice and surface at the North Pole during the Arctic winter. It has now been dramatically demonstrated that the nuclear submarine can make the crossing from the Pacific to the Atlantic at any time of the year and can operate freely and safely under the Arctic ice pack.

248. ANNUAL PROGRESS REPORT -- THE PRESENT STATUS OF CHEMICAL RESEARCH IN ATMOSPHERE PURIFICATION AND CONTROL ON NUCLEAR-POWERED SUBMARINES, V.R. Piatt and E.A. Ramskill, eds. (U.S. Navy, Naval Research Laboratory, Report No. 5630, 14 July 1961, 134 pp.)

This annual progress report supplements NRL Report 5465, April 21, 1960, which was a comprehensive review of the past and present research and development effort of the U.S. Naval Research Laboratory on the atmospheric habitability of submarines. Emphasis is at present being devoted almost exclusively to nuclear-powered submarines. Considerable progress has been made in the major efforts of developing; (a) continuous processes for the electrolytic generation of oxygen from water, including the sulfate-cycle system which also entails the absorption of carbon dioxide, (b) semigloss water-thinned paints which reduce the hydrocarbon contamination levels, and (c) practical installation of additional electrostatic-precipitator capacity for drastically curtailing the atmospheric concentration of aerosols arising chiefly from smoking.

249. FOR YOUR PROTECTION—ATOMIC SUBMARINE LOOKOUTS WARN AGAINST ARCTIC INVADERS. (Advertisement by Raytheon Company, Waltham, Massachusetts)

Sleuthing just beneath the ocean's surface, USS Triton—world's largest submarine—thrusts her giant radar antenna above the arctic sea to scan the skies for aerial intruders.

This Raytheon air-search radar antenna retracts into the superstructure when Triton submerges, yet is strong enough to withstand sudden crash dives.

First nuclear-powered picket sub, Triton can cruise 110,000 miles without refueling. She acts as a fleet scout, or as a floating station to extend the land-based DEW line radar network.

Today, all Navy picket submarines are equipped with Raytheon radars—another example of the skills and knowledge of 39,000 men and women contributing to national security.

250. SERIOUS STRUCTURAL FATIGUE PROBLEMS. (News Item from Underwater Engineering, March/April 1961, p. 48)

Serious structural fatigue problems may be in the offing for deep-diving nuclear submarines. Evidence has been noted in the hulls of some of the older craft. Reason: Much greater depths to which they go, and the fact that their high-speed maneuverability results in many more pressure cyclings than are encountered by conventional boats. There may also be problems of residual stress worked into the structure due to plastic deformation under deep water pressures. Auery: What's the work hardening effect of repeated high pressure cycling? This may be the beginning of our first real insight to some of the problems peculiar to design for repeated operation to great depths. Watch it.

251. ANOTHER POLAR FIRST FOR THE U. S. NAVY'S ATOMIC SUBS. (U. S. News & World Report, News Item, 5 September 1960, p. 6)

Traveling part of the way under ice, the U. S. atomic submarine SEADRAGON traversed the 850-mile short route through the Canadian Arctic islands late in August. It was the first such trip. Always before, ice at the west end of the route forced ships making the Northwest Passage to thread a tortuous southerly route. Later, the SEADRAGON touched at the North Pole, headed for Hawaii. It also had made the first Atlantic-to-Pacific polar crossing by an atomic sub.

252. U. S. GETS A POLARIS SUB BASE ABROAD. (U. S. News & World Report, News Item, 14 November 1960, p. 14)

An agreement with Britain gave the U.S. a base in Scotland for atomic submarines armed with nuclear-tipped Polaris missiles. The pact angered British Laborites and stirred controversy about the degree of control Britain would have over use of the 1,200-mile-range weapons. By next February, two Polaris subs and auxiliaries, including the sub tender PROTEUS, will be at the Firth of Clyde base. Four other subs will join them during 1961.

253. SECRET BASE FOR POLARIS: THREE-FOURTHS OF THE WORLD. (Advertisement by Lockheed in U. S. News & World Report, 5 June 1961, pp. 12-13)

Under the seas that cover three-fourths of the world now moves a new kind of submarine. Nuclear-powered, it runs so swift and so deep it cannot be tracked. It stays submerged for months. It carries 16 Polaris missiles, which it can launch in as many minutes without surfacing. Each missile means total destruction for one strategic target—and few are beyond reach. The U. S. Navy's Polaris submarines turn the global seas into one vast secret missile base, ... end any hope of destroying America's power to strike back after a surprise attack. The Missiles & Space Division of Lockheed is prime contractor and system manager for the Polaris missile—and leader of a nationwide team of thousands of companies, large and small, that have participated in the program.

SECTION B

Torpedoes

254. SPECIAL PURPOSE MARINE PROPULSION SYSTEMS -- 1,2. R. Taggart. (American Society of Naval Engineers Journal, Vol. 71, No. 3, August 1959, pp. 433-437; Vol, 71, No. 4, November 1959, pp. 615-621.)

System for use where certain features of conventional screw propeller militate against its use, including torpedo application. August: Controllable pitch, contra-rotating, and vertical axis propellers; Kort nozzle. November: Air screws; surface propellers; tracked vehicles; hydraulic jets.

255. POLARIS LAUNCHING SYSTEM. D.K. Ela. (Astronautics, Vol. 3, No. 12, December 1958, pp. 40-41+)

Factors underlying selection of launching method and significant design problems, dictated by need for combining launcher and storage magazine in submarine firings of Polaris missile system of U.S. Navy; "Pop-up" concept employing tube ejection unit described.

256. CORROSION PREVENTION FOR POLARIS. H. C. Slaughter. (Astronautics, Vol. 3, No. 12, December 1958, pp. 38-39+)

Practice at Lockheed Missile Systems Division, Sunnyvale, California; special protective finishes, corrosion resistant materials and encapsulation provide capability for withstanding extended periods of constant readiness during storage or stowage of U. S. Navy Bureau of Ordnance Fleet ballistic missile.

257. NAVY ORDERS HOMING TORPEDO PRODUCTION. (Aviation Week and Space Technology, Vol. 73, No. 2, 11 July 1960, p. 129)

Navy has ordered the General Electric-developed MARK 44 active homing torpedo into production after a two-year evaluation, and the weapon will be used by the fleet against high performance nuclear submarines.

MARK 44 torpedo is the conventional payload for the ASROC antisubmarine missile system (AW June 27, p. 32). It can also be dropped from attack aircraft and fired from existing surface shipboard torpedo tubes. MARK 44 has been under development by GE Ordnance Department since 1954.

258. A STUDY OF THE FEASIBILITY OF AN OPTICAL-FLASH ACOUSTIC-PING TRANSPONDER SYSTEM FOR SHORT RANGE UNDERWATER TRACKING. Donald F. Clements. (Electronic Systems Laboratory, Massachusetts Institute of Technology, Cambridge, Contract Nonr-184153, Report No. 8060-R-3, July 1960, 11 p.) AD-240 885*

The use of optical tracking as a possibility for torpedo tracking instrumentation is considered. The system described is that of an active torpedo closing on a submarine. Conclusions reached from the calculations of effective ranges for underwater flashes are given. Specific areas discussed are light source intensity, light attenuation in water, optical noise sources, phototube self noise, sub-surface sunlight, and bioluminescence.

*Available on loan only.

259. NAVY TO GET UNDERWATER DRONE. (Electronics, Vol. 33, No. 30, July 22, 1960, p. 46)

TV-guided underwater workhorse, designed to retrieve torpedoes, has many commercial uses.

260. SURVEY OF UNDERWATER MISSILE TRACKING INSTRUMENTATION. D. T. Barry and J. M. Formwalt. (IRE Proceedings, Vol. 47, No. 5, Part 1, May 1959, pp. 970-977)

Development of instrumentation and current underwater tracking ranges are described; principal tracking method employed is fixed site tracking range in which array of hydrophones receive sound pulses generated in moving vehicle; relative arrival time of pulses, known array geometry, and propagation velocity are employed to compute coordinates, speed and acceleration of underwater missile.

261. SOLID-FUEL CASES TAPPED HARD FOR POLARIS ROCKET ENGINE. Laurence W. Collins, Jr., Assoc. ed. (Machinery, September 1961, pp. 87-92)

What has made the Polaris the most successful and most feared United States deterrent is that it was designed, engineered and is built that way. Even a simple fuel-tank closure for this missile shows the result of practical planning plus sound research.

262. SUBROC PRODUCTION TO START. (News Item from Missiles and Rockets, 12 June 1961, p. 9)

The Navy is planning to begin pilot production of the Goodyear SUBROC in FY '62, but the initial deployment date for the nuclear-tipped underwater-to-underwater missile has become somewhat blurred. The submarine-launched SUBROC was expected to be initially deployed this year. This now appears doubtful.

263. PLUG NOZZLE FOR POLARIS. (News Item from Missiles and Rockets, 14 August 1961, p. 21)

The Navy is considering the use of plug nozzles on its POLARIS fleet ballistic missile to add efficiency and shorten the missile so that more propellant can be used. A plug nozzle configuration would simplify thrust vector control problems and increase reliability by reducing seal failures. The change is expected to be a significant contribution to the Navy's aim of a 2500-mile range POLARIS.

264. NAVY POLARIS AND AIR FORCE MIDAS TOOK SIGNIFICANT FORWARD STRIDES. (News Item from Missiles and Rockets, 30 October 1961, p. 10)

For the first time, a 1500-mile "Polaris A-2" was fired from a submerged submarine, the Ethan Allen. The flight of the 30-ft. missile on October 23 appeared to be successful. But there was no confirmation from the Navy, under a DOD-imposed secrecy rule.

265. RED UNDERSEA THREAT GROWS. (News Item from Missiles and Rockets, Vol. 10, No. 5, 29 January 1962, p. 11)

The Defense Department is increasingly concerned with the threat posed by Soviet missile-launching submarines. The Russians have been known for some time to have conventionally-powered subs capable of launching missiles. Current evidence increasingly indicates that the Soviets also have nuclear-powered missile subs. The missiles are considered to be short range. But even those could obliterate all of the big metropolitan areas on the East and West Coasts.

266. POLARIS SLIPPAGE TO END. (News Item from Missiles and Rockets, Vol. 10, No. 5, 29 January 1962, p. 11)

The Defense Department is planning to end the Administration-imposed day by day slippage in the construction of POLARIS submarines beyond the 29th. The department says it will release funds to the Navy to order long lead-time items for the next six POLARIS subs. However, plans now call for placing the sub-building program beyond the 29th boat on a basis of one every two months--rather than the projected one-a-month.

267. POLARIS BAGGED IN FLIGHT. (News Item from Missiles and Rockets, Vol. 10, No. 5, 29 January 1962, p. 23)

A heavy-duty nylon-webbed net is being used by Lockheed to snare advanced versions of the Navy's POLARIS missile in mid-air. The huge bag captures the 15-ton IRBM as it breaks from the water after being launched from Lockheed's submerged tube.

268. ASROC BECOMES NAVY ASW HAYMAKER. James Baar. (Missiles and Rockets, Vol. 6, No. 26, 27 June 1960, pp. 9-10)

Some 150 ships to get missile during next few years; first public evaluation exercise shown high capability. (Carries General Electric's Mark 44 Torpedo. Some information included on torpedo).

269. NUCLEAR TEST REVIVAL TO BRING DRASTIC MISSILE REVISIONS. James Baar. (Missiles and Rockets, 11 September 1961, pp. 14-15)

U. S. as well as Soviets can make good use of more explosions; maneuvers may be aimed at Polaris subs.

270. SEISMOLOGY TAKES TO UNDERSEA WARFARE. Hal Gettings. (Missiles and Rockets, 9 January 1961, pp. 28-29)

Dresser finds oil hunting techniques apply to identifying, targeting enemy submarines; beacon built for ocean bottom POLARIS navigation.

271. SUBMARINE IDEAL FOR SURPRISE ATTACK. Harry Sanders. (Missiles & Rockets, 24 October 1960, pp. 29-31)

SUBMARINES - UNDERSEA - WARFARE - ANTI-SUBMARINES.

272. SLAG MAKES POLARIS FIRINGS 'FAIL-SAFE'. Ben Strunk, General Precision, Inc., Kearfott Division. (Missiles & Rockets, 9 January 1961, pp. 23-24)

Kearfott-developed system could be installed on surface vessels carrying operational birds; dual unit has perfect record.

273. 'BRAIN' OF THE POLARIS MISSILE. R. B. Walter, General Electric Company, Ordnance Department, Pittsfield, Massachusetts. (Missiles and Rockets, 12 June 1961, pp. 30-31+)

Guidance package designed by MIT lab is smallest of inertial systems in present operational missiles.

274. MAGNESIUM BATTERY CASES LICK MISSILE AND TORPEDO WEIGHT PROBLEMS. (Modern Metals, Vol. 15, No. 2, March 1959, p. 60+)

Aluminum and magnesium used extensively by Yardney Electric Corporation, New York, in manufacture of Silvercel batteries; units are six times lighter and five times smaller than ordinary storage batteries; materials employed; examples of light alloy batteries used in missiles and torpedos.

275. SIMULATION ANALYSIS OF THE TORPEDO MARK 44 MOD 0. Hiroshi Mori. (Naval Ordnance Test Station, China Lake, California. (NOTS 1853; NAVORD Report No. 5630, 27 September 1957, 61 p., CONFIDENTIAL) AD-301 972

276. SIMULATION ANALYSIS OF THE TORPEDO MARK 46 MOD 0 WITH LANA PANEL. Hiroshi Mori, R. L. Schroeder, and L. Z. Maudlin. (Naval Ordnance Test Station, China Lake, California, NAVORD Report No. 6532, NOTS TP 2225, 22 April 1959, 39 p., CONFIDENTIAL) AD-313 691

277. PROJECT SWISH: FIELD STUDIES OF RETORC AND TORPEDO MARK 46 FLOW NOISE. C. R. Nisewanger, J. R. Campbell, R. L. Allman, and W. G. Magnuson. (Naval Ordnance Test Station, China Lake, California, NAVORD Report No. 7035, NOTS TP 2423, 8 February 1960, 38 p., 12 refs., CONFIDENTIAL) AD-317 760

Flow-noise studies utilizing an unpowered buoyant torpedo (the SWISH RETORC) were conducted during the summer of 1958 at Lake Pend Oreille, Idaho. The effects on flow noise of nose shape, speed, and depth were investigated. For moderately smooth skin finishes, the flat nose was 10 to 20 db per speed octave in the range of 30 to 40 knots. Noise level was constant with depth below 100 feet.

The unsmoothes, unpolished Mk 46 Mod 0 evaluation head with a highly directional 38.5-kc transducer and a self-noise level of -38 dbs (referred to 1 dyne/cm^2) in deep water at 40 knots. The surface discontinuities at the transducer joint and the dye-pot cover were the most important noise contributors. Careful smoothing reduced the noise level 30 db.

278. POLARIS UNDERWATER LAUNCH PROGRAM. J. G. Rezin. (U. S. Naval Ordnance Test Station, China Lake, California, NOTS 2055, NAVORD Report No. 5902, Investigations Progress Report No. 2, 3 March-9 June 1958, 46 p., 21 refs., CONFIDENTIAL) AD-302 216

This is the second of a series of reports correlating the model, analytical, and full-scale investigations results of all agencies participating in the Polaris underwater-launch program. Related underwater-launch system characteristics are discussed; a summary of analytical, model, and full-scale test results and a review of new missile working parameters are included. Conclusions are drawn from the material discussed and recommendations made for future areas of investigation.

279. ANALYSIS OF A PROPORTIONAL CONTROLLED PURSUIT GUIDANCE SYSTEM. R. L. Schroeder. (China Lake, California, NOTS Report No. 1720, 22 March 1957, NAVORD Report No. 5444, CONFIDENTIAL)

A new control system for torpedoes was investigated on the Hydrodynamic Simulator. Successful attacks were made from all initial conditions against targets at speeds up to 25 knots. In every case the missile crossed the longitudinal axis of the target less than 25 yards astern, and closed within 20 yards minimum distance of the point source target. Stern closures against high-speed targets crossed forward of the point source. This performance was superior to that obtained with the experimental torpedoes to date.

A linear system gain of 2.0 (azimuth rate to rudder position) resulted in stable and well-behaved trajectories with both double and quadruple pulse repetition rates. For the system studied, successful operation did not require either a quadruple pulse rate or non-linear gain characteristic.

Introduction of lead steering, with a 10-degree limit on the transducer angle, moved the stern closure away from dead astern. Generally, this required less run time, but otherwise did not significantly improve performance.

The possibility of incorporation of this system into present experimental weapons is discussed in Appendix A.

280. ENGINEERING DESIGN & FEASIBILITY STUDY PROPOSAL FOR LONG ENDURANCE PATROLLING TORPEDO (LEPT). (North American Aviation, Columbus Division, Report No. NA60H-168, 21 March 1960, CONFIDENTIAL)

Contents include: LEPT (MODEL); Torpedoes.

281. EVALUATION PROGRAM -- BUORD SUBROC PROGRAM. (North American Aviation, Inc., Missile Division, Downey, California, Report No. MD58-99, 29 April 1958, SECRET/ Limited Circulation)

Contents include: SUBROC (Model); Missiles, guided, submarine; Submarine systems.

282. TOMORROW'S TORPEDOES NOW. W. O. Foss. (Ordnance, September -October 1961, pp. 212-215)

283. CLASSIFIED TITLE. Emerson L. Grindall. (Pennsylvania State University, Ordnance Research Laboratory, University Park, Contract NOrd-26597, 1 March 1960, 17 p., Serial No. NOrd-26597-60, CONFIDENTIAL) AD-315 577

Descriptors: Torpedoes*; Countermeasures; Tests; Naval vessels*; Safety devices*; Antisubmarine warfare.

284. ROCKET TORPEDO. (Rocket-Jet Flying, Summer 1961, pp. 4-5)

285. BULLETIN OF ACTIVITIES IN THE TORPEDO PROGRAM. U. S. Naval Ordnance Test Station, China Lake, California. (Torpedo Quarterly, NAVORD Report No. 5805, November 1957, CONFIDENTIAL) AD-157 088

RAT Goes to Sea, M. D. Blatt; ASROC Thrust Cutoff, M. H. Hamilton; Simulation of Linear Acceleration on a Torpedo Pitch Pendulum, W. D. Olson; Buoyant Location Marker for ASROC, A. M. Lopardo; Tests of Exploder Mechanisms, J. A. Berget; Velocity Fields in Underwater Motion Analysis, L. A. Lopes and D. L. Elliott.

286. SOUNDS OF IGNITION AND ROCKET THRUST OF POLARIS MISSILE. (News Item from Underwater Engineering, Vol. 2, No. 1, January 1961, p. 18)

Sounds of ignition and rocket thrust of POLARIS missile are almost inaudible in a submerged sub. A feature of an educational display at the Chicago Museum of Science and Industry is recorded countdown and launch of the POLARIS from the USS GEORGE WASHINGTON.

287. MARK 44 TORPEDO EVALUATION. (Underwater Engineering, March/April 1961, pp. 18-19)

The Mark 44 acoustic homing torpedo is the U. S. Navy's latest operational torpedo. It can be ship-fired by conventional methods, air-dropped, or ASROC-boosted over 18,000 yds. General Electric's Ordnance Department, Mark 44 manufacturer, operates a Field Test Station for the Navy at Key West where these shots were taken. Mark 44 has speed and depth needed to kill latest nuclear subs.

288. TORPEDO WATER ENTRY. Barron Kemp. (Underwater Engineering, March/April 1961, p. 32)

Aircraft-launched and rocket-thrown torpedoes are subjected to many types of severe mechanical shock excitation throughout their service life.

This is a very critical time in the life of a torpedo since the weapon must accomplish its mission immediately following water entry. Therefore, it is mandatory that all internal electronic and electro-mechanical torpedo components survive this dynamic-loading condition without permanent damage.

289. FEASIBILITY STUDY OF A LONG ENDURANCE PATROLLING TORPEDO SYSTEM. (U. S. Navy, Naval Underwater Ordnance Station, Report No. TM-212, SECRET)

Contents include: ASW (MODEL); Torpedoes; Weapon Systems, nuclear; Anti-submarine warfare.

290. A LONG RANGE, HIGH SPEED, DEEP RUNNING TORPEDO. (U. S. Navy, Naval Underwater Ordnance Station, Report No. R-59-[illegible]-01, CONFIDENTIAL)

Contents include: Torpedoes; Submarine systems; Underwater research.

291. NEW WEAPON ENTERS THE U.S. ARSENAL. (U. S. News & World Report, 1 August 1960, p. 58)

The United States took a big step toward restoring the balance of power in military missiles on July 20.

On that day, the atomic submarine GEORGE WASHINGTON for the first time fired two Polaris missiles while fully submerged, hitting targets 1,200 miles away with "remarkable" accuracy.

These two shots proved the theory behind a whole new weapons system.

292. POLARIS MISSILES FOR FIRST ATOMIC CRUISER? (U. S. News & World Report, News Item, 5 September 1960, p. 16)

Work on the first U. S. nuclear-powered cruiser is 18 months behind schedule. The USS Long Beach now is due to be commissioned in June, 1962, instead of late this year.

The Defense Department indicated it may take advantage of the delay to equip the cruiser with Polaris missiles -- making it the first surface ship able to launch long-range ballistic missiles at strategic targets.

Adapting the Long Beach to handle the Polaris would boost costs from about 300 millions to 800 millions.

293. IS WORLD BALANCE IN MISSILES SHIFTING TO U. S.? (U. S. News & World Report, 23 January 1961, pp. 62-68)

Almost unnoticed, U. S. has moved into a position of devastating power in missiles. Polaris, already deployed, is ready for action. Minuteman is coming along, ahead of schedule. In sheer numbers, Russia still has the edge. But U. S. now has the means to destroy Russia with a variety of fantastic weapons.

SECTION C

ASW (Anti-Submarine Warfare) and UWS (Undersea Weapons Systems)

294. ANTISUBMARINE WARFARE: NAVIGATION, COMMUNICATION, DETECTION, DATA PROCESSING, AND DISPLAY. (Autonetics, a division of North American Aviation, Inc., Downey, California, Report No. EM-1950, 31 August 1959, SECRET.)

Contents include: Submarine systems; SINS (Model); Submarines - Detection; Data Processing.

295. WHICH WAKE IS AN ENEMY SUBMARINE? (News item by Bendix Corporation, Fisher Building, Detroit 2, Michigan, in U. S. News & World Report, Vol. 49, No. 9, 29 August 1960, p. 3)

Thanks to its anti-submarine equipment, the U. S. Navy quickly determined that both suspected "targets" were actually whales. Had they been enemy submarines, however, the Navy was ready to take immediate action.

Protecting this Nation from surprise underwater attack is an ocean-sized problem that's being energetically tackled on a great many fronts. Bendix—with its development and production background in depth recording and indicating instruments, underwater telephones, submarine detection and tracking sonar, scanning sonar, power steering, and other submarine gear—has been assigned the responsibility for much submarine operation and detection equipment.

296. RADAR/SONAR DECOY. John B. Brennan, Jr. and Glenn E. Leydorf. (Chesapeake Instrument Corporation, Shadyside, Maryland, Contract NObsr-72693, Interim Engineering Report for period ending 1 July 1958, 15 July 1958, CONFIDENTIAL) AD-303 897L

297. THE ANTI-SUBMARINE SUBMARINE. (U.) (Electric Boat Division, General Dynamics Corporation, Groton, Conn., Report No. P59-094A; CEB-0721, 1 June 1959, CONFIDENTIAL) AD-319 254

Contents include: Submarine killers*; Submarines; Submarine hulls; Submarine engines; Control systems; Antisubmarine fire control systems; Command systems; Design; Configuaration; Materials; Navigation; Antisubmarine warfare; Production.

298. HOW MILITARY SEES IN DARK. (Electronics, Vol. 32, No. 26, 26 June 1959, pp. 20-23+)

Low-light-level television furnishes eyes for nuclear submarines and space vehicles. Also used in radio astronomy and special fire-control.

299. ANTISUBMARINE WARFARE MARKET WINNING STRONG NEW SUPPORT. (Electronics, Vol. 33, 26 August 1960, p. 24)

300. AIRBORNE RADIOMETER MAY FIND SUBMARINES. (News Item from Electronics, Vol. 35, No. 4, 26 January 1962, p. 7)

An extremely low-noise, wide-band maser amplifier, used as the first r-f stage in a correlative Dicke-type radiometer, may be the answer to successful round-the-clock all-weather detection of submarines from airplanes covering thousands of square miles.

301. NEW SUB KILLER OPENS BIG MARKET: NEW ANTI-SUBMARINE ROCKET, ASROC. J. F. Mason. (Electronics, Vol. 33, 8 July 1960, pp. 28-29)

302. WEAPONS CONTROL SYSTEM STUDY. (General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, Contract Nonr-225300, Final Report, 31 January 1958, CONFIDENTIAL) AD-152 700

This weapon control system report presents the results of studies into submarine data processing as related to fire control and navigation. An early conclusion was that existing submarine processing techniques did not represent the best use of the available data. A statistical technique, specifically the method of "least squares", was applied to determine a best fit for waterborne target parameters (course, speed, and range) to the available target measurements, and for own-ship position to available navigation measurements; the technique would also make possible the determination of standard errors in the computed solutions, thus providing a measure of solution quality. In effect, the least squares method would deliver solutions based on consideration of all available input data rather than discrete sets of data.

303. 400,000-GALLON TEST TUBE FOR ASW RESEARCH. (Advertisement by General Dynamics/Electronics, Military Products Division, Rochester 3, New York, in Underwater Engineering, March/April 1961, p. 11)

ASW research at General Dynamics/Electronics gets a powerful lift from a giant research tool...the largest privately-owned indoor facility for underwater acoustic testing. It's a circular, open-topped test tank, 48 feet across, 30 feet deep, complete with automatic test instrumentation for all types of acoustic measurements.

Overhead equipment, capable of hefting a 2 1/2-ton transducer, can position a target or a transducer anywhere in the tank. Measuring equipment can be placed on the surface, to study the air-water interface as part of an acoustic transmission path. Underwater lights and a viewing port at the fifteen-foot level permit direct observation or photography.

304. ASROC: ANY SHIP A POTENTIAL SUB-KILLER. (News Item from Honeywell Military Products Group)

With the successful testing of ASROC, the newest and deadliest anti-submarine weapon system, the Navy made potential sub-killers out of many ships in the fleet. Existing ships can be equipped with the ASROC system permitting them to protect convoys and coast lines. At the same time, ASROC greatly extends the kill area of each ship permitting swift attack without aneuvers or leaving the convoy.

ASROC was developed by the U. S. Naval Ordnance Test Station (NOTS), Pasadena, for the Bureau of Naval Weapons. As prime contractor, Honeywell is responsible for the entire weapon system, including computer, launcher, missiles and all aspects of control. ASROC is another example where proper planning and capable management by the Armed Services and their contractors have resulted in the efficient use of tax dollars.

305. NEWS ITEM. (Hovering Craft and Hydrofoil, Vol. 1, No. 1, October 1961, p. 46)

According to an American report, the Bureau of Ships is to build a 50-foot test craft shortly and a 150-foot ocean-going craft for experiments and evaluation in anti-submarine warning (ASW) and amphibious work in 1963.

306. SUBIC WEAPONS CONTROL SYSTEM INFORMATION REQUIREMENTS STUDY FINAL REPORT. (Librascope, Report No. FR-59-G-31, 31 July 1959, CONFIDENTIAL)

Contents include: SUBIC (Model); Control systems, weapons; Submarines - Evasion characteristics; Displays, optical; Displays, tactical; Submarines -- Research; Tactical control systems; Submarines - Control systems.

307. THIS IS HOW AN ENEMY MIGHT SEE US. (News Item by Lockheed Aircraft)

An enemy might see us as a nation of 30 prime targets—the 30 great cities that hold 39% of our people, 51% of our industry, most of our leaders. Through his periscope he could see the skylines of 15 of these cities—easy marks for shortrange missiles from his submarines. And though the other 15 lie inland, he could reach them all with sub-launched missiles having a range of only 1,000 miles. Between his subs and our cities stand the Anti-Submarine Warfare forces of the U. S. Navy. In their endless search of the seas around us, they fly hundreds of hunter-killer planes built by Lockheed—America's most experienced ASW contractor. But their job grows harder each year, as submarines run faster and deeper, as sub-launched missiles fly farther. Hence the quickening tempo of Lockheed's ASW work. Several division are now developing and producing destroyers, patrol planes, and advanced electronic systems for underwater detection and communication.

308. TOTAL SUBROC BUY DISCLOSED. (News Item from Missiles and Rockets, 22 May 1961, p. 9)

The Navy has revealed that it plans to spend a total of $100 million on the new "Subroc" ASW missile. The nuclear-tipped Goodyear missile is expected to be deployed for the first time this year, greatly extending the striking range of U. S. hunter-killer submarines.

309. SPECIAL BARGE TO DEPLOY ASW TEST NET. (Missiles and Rockets, News Item, 5 June 1961, p. 9)

The Navy is reported to be converting an ammunition barge for laying on the Atlantic floor new Artemis test receivers for long-range detection of submarines. The high-gain receivers are attached to marine cable laid from the barge, which is being outfitted with special handling equipment and receiving elements designed by Pneumo-Dynamics Corporation.

310. LOOK AHEAD AT ASW R&D. (News Item from Missiles & Rockets, 12 June 1961, p. 9)

The Navy is estimating now that unless it receives a big step-up in RDT&E funding the ASW slice will continue to run between $200 million and $250 million over the next three years. The Navy is requesting $235 million for ASW RDT&E in FY '62. Meantime, the FY '62 budget contains $8.3 million for anti-ASW R&D work in the field of ship noise reduction.

311. AUSSIES DEVELOPING ASW MISSILE. (News Item from Missiles and Rockets, 17 July 1961, p. 11)

The Australian Department of Supply has under development an ASW booster for the Mark 44 torpedo. The missile is said to have twice the range of "Asroc", which also carries the Mark 44. The U. S. has contributed $4 million to the program.

312. ARTEMIS TACKLES PROBLEM OF SURVEILLANCE. (News Item from Missiles and Rockets, 24 July 1961, p. 21)

ARTEMIS—the Navy's program to determine the feasibility of very long-range undersea surveillance—has taken a step forward with the addition of a powerful sonar transducer and "advanced signal processing equipment" aboard the USS Mission Capistrano. The gigantic transducer—weighing hundreds of tons and consuming enough electricity for a town of 50,000—can be lowered into the sea for data gathering and recovered. A sister installation at Argus Island—30 miles southwest of Bermuda—is used in connection with hydrophones that relay sonar echoes to high-gain receivers.

313. DRONE EXTENDS ASW STRIKING POWER. (Missiles and Rockets, 31 July 1961, News Item, p. 21)

A remotely-controlled drone -- nicknamed DASH (Drone Antisubmarine Helicopter) -- has extended the Navy's ability to hit hostile submarines to the limits of its sonar detection capability. Flown from the deck of a destroyer, the Model DSN-1 coaxial-rotor helicopter is armed with homing torpedoes and allows the Navy to attack subs before the enemy craft become aware of the attack. The new drone was developed and produced by Gyrodyne Company of America, Inc.

314. DEVICE SEEN VASTLY IMPROVING ACCURACY OF SUBMARINES' POSITION FIXING. (Missiles and Rockets, Vol. 9, No. 5, 31 July 1961, pp. 36-38)

Koolsman scientist says use of modified aircraft tracker can yield order-of-magnitude advances; details of system.

315. LOCKHEED TO STUDY WHALES FOR ASW DATA. (News Item from Missiles and Rockets, Vol. 10, No. 3, 15 January 1962, p. 21)

Lockheed-California Co. plans to plant a small sonar transmitter on the back of a whale in an effort to obtain data of value to antisubmarine warfare and studies. The miniaturized electronic gear will be planted on the whale's back from a small plane. Signals from the equipment will be tracked by an recorded aboard the Sea Quest, the company's floating marine laboratory.

316. NAVY CONSIDERS HYDROFOIL FLEET. James Baar. (Missiles and Rockets, 23 May 1960, pp. 12-13)

The Navy's answer to the Soviet missile-launching submarine may be an antimissile missile-packing hydrofoil destroyer.

The Navy is seriously considering the development of a hydrofoil destroyer as the first of a great fleet of possibly several hundred.

317. WHY THE NAVY SUDDENLY WANTS 100 NUCLEAR-POWERED ASW SUBMARINES. James Baar. (Missiles & Rockets, 7 November 1960, p. 11)

318. COMMITTEE WINS G-D $10 MILLION IN CONTRACTS. William Beller. (Missiles and Rockets, 1 May 1961, p. 36+)

An M/R report on how a top ASW contractor effectively coordinated its divisional efforts, with happy results.

319. NODC EAGER FOR ADVICE FROM INDUSTRY. William Beller. (Missiles and Rockets, Vol. 9, No. 21, 20 November 1961, p. 22)

Oceanographic Data Center will supply companies with free processing and equipment-design information; agency wants help in planning its 'modular' data system.

320. UNIQUE FLEET OF ASW STUDY SHIPS URGED. Richard Van Osten. (Missiles and Rockets, 5 June 1961, pp. 32-33)

Design proposed by Douglas would center around steel sphere, have range of 100 n. mi., speed of 5 knots.

321. INNER SPACE. (News Item from Missiles & Space, April 1961, p. 10)

A long overdue interest in our own planet's basic phenomena is growing vigorously. It is estimated that oceanography will budget at $650,000,000 in the next ten years, excluding ASW efforts, under the Marine Sciences and Research Act, of which successful passage by Congress is anticipated. Needless to say, the submarine is the reason for much of the interest, for its pursuit has been spectacularly unsuccessful and revealed many gaps in our geophysical knowledge. The interest extends all the way to archaeology, where scuba-diving has brought up some of the best preserved specimens of all ages.

322. MINUTES OF MEETING OF THE DETECTION AND CLASSIFICATION TASK COMMITTEE OF THE NSIA ANTI-SUBMARINE WARFARE ADVISORY COMMITTEE. (National Security Ind. Assoc., Report No. R-5041, 28 January 1959, SECRET.)

Contents include: Submarines - Detection; Countermeasures systems.

323. OCEANOGRAPHY ABOARD THE TRITON. M. Smalet, H. Mabry and G. Wilkes, U. S. Navy Hydrographic Office, Washington, D. C. (Naval Research, September 1961, pp. 1-7)

In February 1960, the Hydrographic Office was presented with a unique opportunity for a trio of scientists to conduct coordinated research in geophysics and oceanography. The Commander of the nuclear submarine TRITON, had chosen, as a shakedown cruise, to make an epochal circumnavigation of the globe while submerged. Inasmuch as this circumnavigation would provide the means of obtaining continuous data profiles through many relatively untraveled and unknown areas, the Hydrographic Office hastened to install on board equipment for oceanographic, bathymetric, and geophysical surveys.

324. NEW SENSE OF URGENCY. Edmund B. Taylor, U. S. Navy, Anti-Submarine Defense Force, U. S. Atlantic Fleet. (Navy, April 1961, pp. 12-15)

The Navy's appreciation of the vast underwater jungle of shifting masses of water beneath which our own submarines can hide makes it realize how difficult the problems are.

To this end the Navy has created a global Anti-Submarine Defense Force—poised to provide protection to the continent of our country.

325. A PRELIMINARY REPORT ON A MATHEMATICAL MODEL FOR THE GENERAL ASW VARIABLES STUDY. (North American Aviation, Inc., Columbus, Ohio, division, Report No. NA58H-483, 23 September 1958, CONFIDENTIAL)

Contents include: ASW (Model); Submarine systems

326. ANTISUBMARINE WARFARE. A REVIEW OF CURRENT PROGRAMS IN ASW. (North American Aviation, Inc., Columbus, Ohio, division Report No. NA59H-249, 14 May 1959, CONFIDENTIAL)

Contents include: ASW (Model); Weapons, antisubmarine; Submarines - Detection.

327. PROGRESS REPORT PHASE I - FEASIBILITY STUDY OF CARRIER BASED VTOL/STOL AIR WEAPON SYSTEMS FOR ASW. (North American Aviation, Inc., Columbus, Ohio, division, Report No. NA 59H-454, 31 August 1959, CONFIDENTIAL)

Contents include: VTOL (Vertical Takeoff and Landing) (Model); STOL (Short Takeoff and Landing) (Model); ASW (Antisubmarine Warfare) (Model); Submarine Systems.

328. NEW BUSINESS EVALUATION OF ANTISUBMARINE WARFARE MARKETS. (North American Aviation, Inc., Report NA 61H-330, 1 May 1961, approx. 50 p., CONFIDENTIAL)

Market research. Antisubmarine warfare—Economic aspects.

329. AN APPRAISAL OF ORO'S DEFENSE STUDY, R-17 (U). A. Wohlstetter. (RAND Corporation, Report No. RM-2120, 21 February 1958, SECRET.)

Contents include: Defense systems, overall; Weapon systems, low-altitude; ECM (Electronic countermeasures); Submarine systems.

330. EARLY WARNING FROM TRITON SUB OVER 110,000 MILES RANGE. (News Item from Space/Aeronautics, January 1960, p. 29)

Recently commissioned Triton submarine will have a cruising range of 110,000 miles and carry a crew of 173 men. She is fitted with high power radar and sonar gear for early-warning detection of enemy planes, submarines, and surface vessels. Cost is put at $100 million.

331. NEW THREATS, NEW REQUIREMENTS, NEW FRONTIERS. Randolph Hawthorne, ed. (Space/Aeronautics, January 1960, p. 17)

Aerospace technologies are applied to problems of the sea frontier. We desperately need breakthroughs in UWS detection and communications. Merely to find a submarine in the vast oceans is beyond the reach of today's knowhow. Communications to and from undersea conditions are far short of needs.

332. SINGLE AGENCY FOR ASW! Robert M. Loebelson. (Space/Aeronautics, January 1960, p. 21)

L. B. Richardson, senior vice president -- engineering, General Dynamics Corporation -- insists that once the Navy makes up its mind that the special-projects approach to ASW is desirable, it should also define what weapon systems ASW should include and fund all of its ASW work through that office.

333. UNDERSEA WEAPON SYSTEMS; SPECIAL REPORT. PART I. INDUSTRY VIEWS THE FUTURE OF UNDERSEA WEAPON SYSTEMS. Robert M. Loebelson, assoc. ed. (Space/Aeronautics, January 1960, pp. 39-42)

S/A survey gets industry's viewpoints on critical UWS problems, growth possibilities, government leadership.

334. UNDERSEA WEAPONS SYSTEMS; SPECIAL REPORT. PART II. NEW SYSTEMS CONCEPTS DEVELOPING FOR UNDERSEA WEAPONS. Victor de Biasi, assoc. ed. (Space/Aeronautics, January 1960, pp. 43-47)

Whole families of underwater vehicles? Weapon-systems approach looks promising. Submarine teams are in the offing.

335. UNDERSEA WEAPON SYSTEMS. SPECIAL REPORT PART III. CATCHING UP WITH THE SUBMARINE. Paul Cohen, Sperry Gyroscope Co., Anti-Submarine Warfare Section, Great Neck, New York. (Space/Aeronautics, January 1960, pp. 48-50)

Physical conditions stacked in favor of submarines.
Effective submarine detection feasible but far off.
ASW weapon development making good progress.

336. UNDERSEA WEAPON SYSTEMS; SPECIAL REPORT. PART IV. THE UNDERSEA ENVIRONMENT. Bernard Kovit, assoc. Electronics ed. (Space/Aeronautics, January 1960, pp. 51-57)

Review of some basic characteristics of the undersea environment. Major topics include the ocean floor, sediments, currents, and properties and phenomena of sea water medium. A pullout chart of major oceanographic features of North Atlantic.

337. UNDERSEA WEAPON SYSTEMS.* PART V. STATE OF THE ART: DETECTION AND COMMUNICATIONS. James Holahan, Electronics ed. (Space/Aeronautics, January 1960, pp. 58-63, 1 ref.)

Most sub detection still relies on sonar.
Electromagnetic "window" remains elusive.
Satellites may solve communications problems.

*Special Report.

338. UNDERSEA WEAPON SYSTEMS.* PART VI. STATE OF THE ART: GUIDANCE AND NAVIGATION. Bernard Kovit, assoc. Electronics ed. (Space/Aeronautics, January 1960, pp. 64-67)

FBM subs to use inertial guidance.
Fairly low frequencies for radio systems.
Extensive signal processing is needed.

*Special Report.

339. UNDERSEA WEAPON SYSTEMS.* PART VII. STATE OF THE ART: PROPULSION. Victor de Biasi, assoc. ed. (Space/Aeronautics, January 1960, pp. 68-71)

Thermoelectric systems can fill dual role.
Fuel cells look most practical right now.
Jet thrust systems are being studied.

*Special Report.

340. UNDERSEA WEAPON SYSTEMS.* PART VIII. STATE OF THE ART: HYDRODYNAMICS, STRUCTURES, MATERIALS. Irwin Stambler, assoc. ed. (Space/Aeronautics, January 1960, pp. 72-75)

Designers no longer "freeze" ocean surface.
Higher speeds through nuclear power.
Detail design is extremely critical.

*Special Report.

341. UNDERSEA WEAPON SYSTEMS.* PART IX. CAVITATION PROBLEMS LOOM LARGE IN UNDERWATER MISSILE DESIGN. Robert H. Oversmith, General Dynamics Corporation, Convair Division, Hydrodynamic Model Basin, San Diego, California. (Space/Aeronautics, January 1960, pp. 77-78+)

Drag coefficient depends only on cavitation number.
Nucleus content influences development of cavities.
Cavitation seen as violently oscillating process.

*Special Report

342. UNDERSEA WEAPON SYSTEMS.* PART X. HOW TO BUILD A HYDRO-ACOUSTIC TEST TANK. Richard L. Beam, Hazeltine Corporation, Hazeltine Electronics Division, Little Neck, New York. (Space/Aeronautics, January 1960, pp. 89-92+)

Tank better than the ocean or a lake.
Noise from outside must be suppressed.
Depth of 2400 ft can be simulated.

*Special Report.

343. UNDERSEA WEAPON SYSTEMS.* PART XI. UNDERSEA WEAPON SYSTEM ROUNDUP. (Space/Aeronautics, January 1962, pp. 101-104+)

Virtually all activities involving offensive and defensive undersea warfare are the responsibility of the Navy. Among the many and highly diverse weapon systems this service has in operation or under development are: Aircraft; Non-rigid airships; Missile, Torpedoes, Rockets; Submarines; Helicopters.

*Special Report.

344. INTERIM REPORT FUTURE WEAPONS STUDY. (Sperry Gyro. Co., Report No. R-5285-7236, October 1955, SECRET)

Contents include: ASW (Model); Submarines -- Armament; Submarines -- Detection; Sonar.

345. ASW DIVISION OF AEROJET-GENERAL CORP. SPLIT. (News Item from Undersea Technology, November-December 1961, p. 14)

The ASW Division of Aerojet-General Corp. has been split into two independent units—the Oceanics Division under the direction of former ASW Div. manager Calvin A. Gongwer and the Torpedo Division headed by George M. McRoberts. Some of the projects now underway at the oceanics Div. are underwater remote controlled utility drones, ocean turbulence meters, silent fluid transmission valves, and underwater communications defense systems. The Torpedo Div. is concerned with research, development, testing and production of underwater weaponry.

346. $1 MILLION SHORE-BASED TRAINER. (News Item from Undersea Technology, November/December 1961, p. 14)

A $1 million shore-based trainer for the Navy's ASROC anti-submarine weapons system has gone into operation at the Norfolk Navy Base. The trainer, built by the Ordnance Division of Minneapolis-Honeywell, consists of a number of consoles to locate and track enemy subs, compute their course, range and speed, aim the ASROC launcher and fire the missile.

347. TO KILL A SUBMARINE YOU'VE GOT TO FIND IT. (Undersea Technology, Vol. 2, No. 6, November/December 1961, p. 21)

To kill a submarine, you've first of all got to find it, and therein lies the bulk of the U. S. ASW effort. By comparison the final act of destroying it is relatively simple—particularly with a nuclear warhead—though even here there is a pressing need for ASW weapons with greater effective range.

348. PULSED ULTRAVIOLET RADIATION FOR SUBMARINE DETECTION? Andrew Madsen. (Undersea Technology, Vol. 2, No. 2, May-June 1961, pp. 40-41)

A new idea in the realm of submarine detection, which permits "visual observation" in the dark, is SEA-DATA, an airborne reconnaissance system employing pulse near-ultraviolet radiation. This unique and novel concept utilizes condenser-discharge flashtubes that emit large magnitude pulses of near-ultraviolet radiant energy to an appreciable area of the ocean's surface. Radiated in this manner, during conditions of darkness, the surface will exhibit coherent patterns of fluorescence and associated visual phenomena caused by various factors in the otherwise invisible wake evidence.

349. ASW AND UNDERSEA RESEARCH AT AEROJET-GENERAL CORPORATION. (Underwater Engineering,* Vol. 1, No. 1, pp. 28-30)

Aerojet's Anti-Submarine Warfare (ASW) Division, directed by Calvin A. Gongwer, works in close coordination with the United States Navy and is doing something about the situation. The division is working on a multi-million dollar Navy contract for the design, development and production of a high-speed ASW torpedo of radical design. Besides the torpedo itself, handling, launching, and fire control equipment as well as special component parts are also being devised for this complete torpedo weapon system. This work is under the management of George M. McRoberts.

* First Issue.

350. PASSIVE SILENT UNDERWATER DETECTION SYSTEM CONTRACT. (News Item from Underwater Engineering, Vol. 2, No. 1, January 1961, p. 18)

Passive silent underwater detection system contract for $4.5 million has been awarded to Sperry and will be under the direction of the Naval Ordnance Lab. The accurate and wide range system is compatible with existing fire control equipment and is scheduled for installation in operational subs as well as those under construction.

351. ASW, USW AND OCEANOGRAPHY ANALYSIS. (Underwater Engineering, Vol. 2, No. 1, January 1961, pp. 32-35)

The following short articles are included: '60 Systems Development Improved ASW Prowess; Hydrodynamic Research was Friutful in 1960; Sound Propagation Study Poses a 1961 Challenge; Hopes Held for Awareness of Undersea Potential; 1961 is Crucial Year for ASW Field Growth; a Prime UE Need is Accurate Instrumentation; Oceanography Stimulates Congressional Interest.

352. ASW SURFACE CRAFT. CONTRACT FOR AIR CONDITIONING. (News Item from Underwater Engineering, March/April 1961, p. 8)

Contract for air conditioning Grumman Aircraft Engineering Corporation's turbine-powered hydrofoil has been placed with Garrett Corporation's AiResearch Manufacturing Company, division, Los Angeles. AiResearch already has a contract to provide Grumman hydrofoil with gas turbine auxilliary power.

353. ASW SURFACE CRAFT. MARITIME ADMINISTRATION. (News Item from Underwater Engineering, March/April 1961, p. 8)

Maritime Administration is pulling universities into ship-design programs, as fast as contracts can be signed and money made available. Latest moves: Four contracts with as many universities, to study means of designing more productive and efficient ships; and a new contract (with Stanford Research Institute) for further studies of potentials of hydrofoil craft.

354. U. S. NAVY'S SUBMARINERS. (News Item from Underwater Engineering, March/April 1961, p. 48)

The U. S. Navy's submariners are the only ones in the Pentagon, it's said, standing a heel and toe watch. That's salty talk for around-the-clock close vigilance. The statement emphasizes the critical nature of the undersea environment to this nation's security—also the still not fully comprehended future that awaits mankind in both war and peace beneath the ocean waves. For this reason, with this issue, this column becomes a regular feature of Underwater Engineering. It, like the submariners, will keep a close watch on the whole state of the undersea art; tactical and strategic developments in ASW and PSW; news, views and prospects of the Navy's total underseas effort; and constitute, in effect, a sounding board for comments and ideas.

355. NAVY STRIPS WRAPS FROM ATOMIC LULU. (News Item from Underwater Engineering, March/April 1961, p. 49)

When the normally reticent Navy talks about Lulu, they cite some statistics that would make any girl proud. Lulu is smaller than Betty, weighs 1/3 as much, is much easier to handle, can do the job better, will stand up longer under the strain, and requires less care—only about 59-60 man-hours per month. The only bad fault—and it's a good one as far as the Navy is concerned—is that she makes more noise than Betty. Both are nuclear depth bombs for use against submarines.

356. ELECTRO-ACOUSTIC TRANSDUCER FOR UNDERSEA WARFARE. Leon W. Camp, Bendix-Pacific Division, Bendix Corporation. (Underwater Engineering,* Vol. 1, No. 1, pp. 26-27, 4 refs.)

Transducers may be classified as to purpose, frequency, principle of conversion, bandwidth, etc. Operation at frequencies much above 50 KC is to achieve high resolution at short range, while operation below 10 KC is commonly used to get long ranges with high power output. To mention types in wide use according to principle of power conversion, transducers may be piezoelectric, electrostrictive, magnetostrictive, electromagnetic, reluctance, etc.

*First Issue

357. UNDERWATER SOUND. A. N. Glennon, U. S. Navy. (Underwater Engineering, Vol. 2, No. 2, March/April 1961, pp. 27-28)

A comprehensive rundown of acoustical principles as they apply to latest ASW.

358. TORPEDO COUNTERMEASURES. James C. Moore and Charles C. Cartwright, U. S. Navy Mine Defense Laboratory, Torpedo Countermeasures Branch. (Underwater Engineering, March/April 1961, pp. 33-34)

Defending our ships in a future war where large amounts of overseas shipping are required could place prohibitive demands on conventional Anti-Submarine Warfare and naval escorts. In such an event, it is unlikely that sufficient escort vessels will be available. In both previous wars escort vessels always were in short supply. For this possibility, a torpedo countermeasures system is requisite both for protection and morale.

359. OPTICS IN ASW ENGINEERING. Alfred J. Zaehringer. (Underwater Engineering, Vol. 1, No. 1, pp. 41-44)

When considering underwater viewing whether via the eye, photo-camera, or TV, two important factors must be considered:
1) Absorption and scattering of various spectral regions of the electromagnetic spectrum (EM).
2) Effect of intensity.
Using these principles, the science of underwater optics has suddenly opened up new vistas in viewing. Underwater photography, for example, has played an important role in such an event as recording retrieval of ballistic missile nose cones from the ocean.

360. KILLING NUCLEAR SUBMARINES. George P. Steele, U. S. Navy. (U. S. Naval Institute Proceedings, Vol. 86, No. 11, November 1960, pp. 44-51)

The ocean itself is the greatest single obstacle to ASW. To a greater or lesser extent, its vagaries influence every device we have to look into the submarines medium. In a war of submersibles, cold or hot, the country who knows the sea best can control it. Some of the difficulties of tracking and killing nuclear submarines are discussed in the articles.

361. ASW ANTI-SUBMARINE WARFARE. (U.S. Navy, Report No. R-59-E-14, 1959, UNCLASSIFIED)

Contents include: ASW (Model); Submarines - Detection.

362. PATROL NUMBER ONE SECTION LIMA U.S.S. PATRICK HENRY SSB(N)-599. (U. S. Navy, Report No. R-61-C-08, 30 December 1960-8 March 1961, CONFIDENTIAL)

Contents include: PATRICK HENRY (MODEL); Submarines, FBM.

363. USS GEORGE WASHINGTON SSB(N)-598 PATROL NUMBER TWO SECTION LIMA MATERIAL PERFORMANCE DATA. (U. S. Navy, Report No. R-61-D-25, 22 February 1961-25 April 1961, CONFIDENTIAL)

Contents include: GEORGE WASHINGTON (MODEL); Submarines, FBM.

364. U.S.S. PATRICK HENRY SSB N-599 PATROL NUMBER TWO SECTION LIMA MATERIAL PERFORMANCE DATA. (U. S. Navy, Report No. R-61-F-03, 8 April-2 June 1961, CONFIDENTIAL)

Contents include; PATRICK HENRY (MODEL); Submarines - Design; Submarines - Performance.

365. USS PATRICK HENRY SSBN-599 PATROL NUMBER THREE SECTION LIMA MATERIAL PERFORMANCE DATA. (U. S. Navy, Report No. 61-G-04, 4 July-28 August 1961, CONFIDENTIAL)

Contents include: PATRICK HENRY (MODEL); Submarines - Design; Submarines - Performance; Submarines - FBM.

366. U.S.S. ROBERT E. LEE - SSBN-601 PATROL NUMBER TWO SECTION LIMA MATERIAL PERFORMANCE DATA. (U. S. Navy, Report No. R-61-H-09, 9 August 1961-3 October 1961, CONFIDENTIAL)

Contents include: ROBERT E. LEE (MODEL); Submarines, FBM; Submarines - Performance.

367. REPORT ON INSTRUMENT AND NAVIGATION EQUIPMENT CAPABILITIES FOR CARRIER-BASED ASW AIRCRAFT. (U. S. Navy N.A.D.C., Report No. NADC-AI-5732, 14 June 1957, CONFIDENTIAL)

Contents include: ASW (model); Submarines, FBM; Navigators, inertial.

368. AIRCRAFT/SUBMARINE COOPERATION IN ASW OPERATIONS. (U.S. Navy, N.A.D.C., Report No. NADC -WR-5920, September 1959, SECRET.)

Contents include: Weapon systems, Navy; ASW (Model); Submarines, research.

369. ASW ELECTRONIC MARINE MARKER SYSTEM. FIRST QUARTERLY PROGRESS REPORT. (U.S. Navy, Naval Air Development Center, Report No. ASWM-1Q, August 1960, CONFIDENTIAL)

Contents include: ASW (Model); Markers, Marine; Sonobuoys; Submarines - Detection; Submarines - Acoustic Properties; Measurements, Acoustical; c.r. HUGHES AIRC. CO. QPR-1-60.

370. ASW ELECTRONIC MARINE MARKER SYSTEM. QUARTERLY PROGRESS REPORT. (U. S. Navy N.A.D.C., Report No. ASWM-2Q, November 1960, CONFIDENTIAL)

Contents include: ASW (MODEL); c.r. HUGHES AIRC. CO. QPR-2-60; Markers, Marine; Sonobuoys; Submarines - Detection; Submarines - acoustic properties; Measurements, Acoustical.

371. ASW ELECTRONIC MARINE MARKER SYSTEM. QUARTERLY PROGRESS REPORT. (U.S. Navy, N.A.D.C.*(R&D Library), February 1961, Report No. ASWM-3Q, CONFIDENTIAL)

Contents include: ASW (Model); Markers, Marine; Sonobuoys; Submarines - Detection; Submarines - Acoustic Properties; c.r. HUGHES AIRC. CO. QPR-3-60; Measurements, Acoustical.

*Naval Air Development Center

372. TECHNICAL NOTE. SIMPLIFIED METHOD FOR OBTAINING THE ACQUISITION PROBABILITIES FOR AIR-LAUNCHED WEAPONS IN ASW ATTACK ANALYSES (U). C. F. Warren. (U. S. Navy, Naval Air Development Center, Report No. AW-N6017, 1 February 1961, CONFIDENTIAL)

Contents include: ASW (Model); Weapon Delivery Systems; Target Studies; Probability, hit; Probability, kill; Submarines -- Detection; Submarines -- Vulnerability; Helicopters, assault.

373. DESCRIPTIONS AND REQUIREMENTS FOR THE SUBROC WEAPONS SYSTEM. (U.S. Navy, Naval Ordnance Laboratory, Report No. DR-100, 17 March 1958, SECRET)

Contents include: SUBROC (Model); Submarine systems.

374. THE ASW FIELD. (U.S. Navy, Naval Ordnance Test Station, Report No. R-129-59, 31 March 1959, SECRET)

Contents include: ASW (Model); Submarines - Detection; Weapons, antisubmarine.

375. ON 15 MINUTES' NOTICE: HOW U. S. PLANS TO STRIKE BACK. (U. S. News & World Report, 29 August 1960, p. 53)

A quick, devastating counterpunch to any surprise attack from Russia is being set up.

U. S. weapons--land, sea, air--will be pointed at Soviet targets, ready to fire on short notice at a single command.

376. SUBMARINE TARGET STRENGTH VARIATIONS FOR MONOSTATIC AND BISTATIC ECHO-RANGING GEOMETRIES. (Woodshole Oceanographic Institute, Report No. Ref. 60-24, January 1960, CONFIDENTIAL)

Contents include: Target Studies; GRENADIER (Model); Submarines -- Tracking; SUDEX (Model); Ranging Systems; Submarines -- Blast Effects; Echoes, Radar.

SECTION D

Oceanography

377. SMALL-SCALE TURBULENCE IN THE SURFACE LAYER OF THE SEA ROUGH WITH FULLY DEVELOPED WIND WAVES. S. A. Kitaigorodskii. (Akademiia Nauk SSSR, Institut Okeanologii, Trudy, Vol. 52, 1961, pp. 87-96)

378. INTERNATIONAL OCEANOGRAPHIC CONGRESS. HELD 31 AUGUST - 21 SEPTEMBER 1959, WASHINGTON, D.C. (American Association for the Advancement of Science, 1959.)

RCL: GC2/Am3i/B15475

379. OCEANOGRAPHY; INVITED LECTURES PRESENTED AT THE INTERNATIONAL OCEANOGRAPHIC CONGRESS HELD IN NEW YORK, 31 AUGUST -- 12 SEPTEMBER 1959. Mary Sears, ed. (American Association for the Advancement of Science, 1961, Pub. #67. $14.75.)

A/N Library, Downey: 551.46/Am3o/1959/B118997

380. EXPERIMENTAL TURBIDITY CURRENTS ON THE SEA FLOOR. E. C. Buffington. (American Association of Petroleum Geologists Bulletin, Vol. 45, 1 August 1961, pp. 1392-1400, Bibliog.)

381. WATER EDDY FORCES ON OSCILLATING CYLINDERS. A. D. K. Laird and others. (American Society of Chemical Engineers Proceedings, Vol. 86, November 1960, pp. 43-54, Bibliog.)

382. DEEP WATER WAVE GENERATIONS BY MOVING WIND SYSTEMS. B. W. Wilson. (American Society of Chemical Engineers Proceedings, Vol. 87, May 1961, pp. 113-141, Bibliog.)

383. DIRECTIONAL STABILITY AND STEERING OF SHIPS IN OBLIQUE WAVES. B. V. Korvin-Kroukovsky. (American Society of Naval Engineers Journal, Vol. 73, August 1961, pp. 483-487, Bibliog.)

384. WATER WAVES. J.D. Pierson. (American Society of Naval Engineers Journal, Vol. 73, May 1961, pp. 403-406)

385. NOVEL MARINE PROPULSION DEVICES. R. Taggart. (American Society of Naval Engineers Journal, Vol. 70, No. 4, November 1958, pp. 643-652; Vol. 71, No. 1, February 1959, pp. 31-42)

November 1958: Oscillating blades; propulsive methods of fish; utilization of wave and wind power. February 1959: Unusual adaptations of screw propellers; mechanical propulsion for swimmers; buoyant propulsion of ships; gas jet propulsion.

386. SUBMARINE HYDRAULICS: DESIGNING FOR SAFETY AND SILENCE. (Applied Hydraulics & Pneumatics, Vol. 13, February 1960, pp. 62-65)

387. EXPLORATION SOURS-MARINE. Demitri Rebikoff. (B. Arthaud, Paris, 1952.)

Contents include: Oceanography; Underwater Studies; Marine Studies.

RCL: GC57/R24e/R1574 -- $3.28

388. GENERAL ASSEMBLY AT HELSINKI, JULY-AUGUST 1960. (Association D'Oceanographie Physique, Elanders Boktryckeri Aktiebolag, Goteborg, 1960.)

RCL: GC1/ As7g/R833

Contents include: Oceanography.

389. OCEANOGRAPHY: ITS TOOLS, METHODS, RESOURCES, AND APPLICATIONS. Vol. I. R.D. Terry, Autonetics, Research and Development Center, Anaheim, California. (To be published by 1963, by Macmillan Co., New York; Vol. II is now in process)

This book by R.D. Terry is not only intended for industries, in order to give them ideas on the value of the sea -- profit-wise -- but may be well used as a text book in schools for oceanography.

390. ELECTRONIC TECHNIQUES IN OCEANOGRAPHY. M.J. Tucker. (British IRE, Vol. 20, No. 12, December 1960, pp. 921-931)

General factors governing the design of electronic equipment for oceanographic use, and the design of housings for withstanding high pressures are discussed. Two wave recorders are described: a shipborne wave recorder, and an f.m. pressure gauge which has a resolution of 1 part in 10^6 of full scale and which is suitable for digital recording and analysis.

391. REPORT ON THE NATIONAL INSTITUTE OF OCEANOGRAPHY, 1949/50. National Oceanographic Council, Wormley, England (Surrey). (Cambridge, University Press, Report ends March 31. Report for 1949/50 issued by the National Institute of Oceanography.)

RCL: GC1/N21a/

392. PROTECTION FOR UNDERWATER INSTRUMENTS. H. E. Edgerton and L. D. Hoadley. (Communication and Electronics, January 1961, pp. 689-694, Bibliog.)

393. THE STORY OF THE OCEANS. John Scott Douglas. (Dodd, Mead, New York, 1952, 315 p.)

RCL: GC51/D74s

394. EXPLOITING THE OCEANS: INDUSTRY'S NEXT FRONTIER. (Dun's Review and Modern Industry, Vol. 75, No. 2, February 1960, p. 55+)

395. LE BATHYSCAPHE. Georges Houot and Pierre Willm. (Editions de Paris, Paris, France, 1954, $1.64, RCL: R1571/GC83/ H81b)

Contents include: Submarines; Oceanography.

396. PREMIER DE PLONGEE. Commandant Le Prieur. (Editions France Empire, Paris, France, 1956, $1.42.) RCL: R1573; GC57/L55p

Contents include: Oceanography; Submarines; Aviation.

397. OCEANOGRAPHY: DEFENSE MUST. (Electronics, Vol. 32, No. 38, 18 September 1959, p. 18+)

Claims that warm water pockets and magnetic fields can conceal submarines. Lists Soviet efforts.

398. NEW SONAR THUMPER CHARTS OCEAN SUBBOTTOM. (Electronics, Vol. 34, 3 February 1961, pp. 56-57)

399. TELEMETRY AUTOMATES OCEANOGRAPHIC RESEARCH. Lorraine Smith, McGraw-Hill News. (Electronics, 22 September 1961, pp. 22-23)

Automated oceanic research project gets underway this month off the coast of Florida. Its sponsors at Texas A&M College hope the project may lead to the Gulf of Mexico becoming a huge oceanic laboratory.

400. OCEANOGRAPHIC RESEARCH SUBMARINE OF ALUMINUM FOR OPERATION TO 15,000 FT. (Engineer, Vol. 209, April 15, 1960, pp. 642-643)

401. POLARIS—DESTROYER FROM THE DEEP. (Flight, Vol. 78, No. 2680, 22 July 1960, pp. 115-119; Vol. 78, No. 2681, 29 July 1960, pp. 147-150)

Operational requirements of submarine-launched ballistic missiles are described; early United States development and firing techniques; shipboard environment; launching procedure; Polaris timetable. July 29: Tests carried out since 1957; hydrodynamic performance; recovery techniques.

402. MOLECULAR PHYSICS OF THE SEA. PART VIII, SECTION 10-17. V. V. Shuleykin. (Fizika Morya, 3d ed., 1953, pp. 786-819) (NRL Translation 797, 1960, 40 p., 12 refs.) (Order from OTS, 60-21588, $1.25)

The topics included here are entitled: (1) surface active films on the sea, (2) some properties of surface films, (3) a critique of the hypothesis suggested to explain the damping of waves by oil, (4) the absorption of energy in the surface film, (5) the mechanism of damping of waves by active films, (6) the damping of small waves, (7) the speed with which films spread over the surface of water, and (8) the removal of films under the action of the wind.

403. MIDDLE AMERICAN TRENCH: TOPOGRAPHY AND STRUCTURE.* R. L. Fisher and G. G. Shor, Jr. (Geological Society Bulletin, Vol. 72, May 1961, pp. 703-729, Bibliog.)

*Oceanography

404. POWER SPECTRUM ANALYSIS OF WAVE MOTION, SUBMARINE ROLL ANGLE, AND RELATIVE CROSS-FLOW VELOCITIES. CRUISE II. USS REDFIN (SS-272). P. S. DeLeonibus. (Hydrographic Office, Washington, D. C., Technical Report No. TR-100, February 1961, 61 p., 12 refs.) AD-252 717

This publication presents a discussion of digital and analog recordings of surface wave motion and ship and fluid motions, respectively. These recordings were made while a submarine was hovering at different relative headings. Results of power spectral analysis of resultant data are given.

405. PINGERS AND THUMPERS ADVANCE DEEP-SEA EXPLORATION. J. B. Hersey, Woods Hole Oceanographic Institution, H. E. Edgerton, Massachusetts Institute of Technology, S. O. Raymond and G. Hayward, Edgerton, Germeshausen & Grier, Incorporated, Boston. (ISA Journal, Vol. 8, No. 1, January 1961, pp. 72-77, Bibliography)

Since sound is the only radiation that will penetrate more than a few hundred feet of water, oceanographic instruments must use sound as their medium for distance measurement, location of objects, surfaces and interfaces, and even for data transmission. Two new sonic transducers -- a pinger and a thumper -- provide much increased accuracy to underwater exploration.

406. UNDERWATER INSTRUMENTATION, PREPRINTS ON. (Presented at 15th Annual Instrument Automation Conference and Exhibit - 26-30 September 1960, New York City, $8.00 -- Instrument Society of America.)

Contents include: Instrumentation Underwater; Oceanography.

RCL: QC53/In7u/ 1960/ R1700

407. EXPLORING SUBSURFACE WAVES WITH NEUTRALLY BUOYANT FLOATS. T. E. Pochapsky. (ISA Journal, Vol. 8, October 1961, pp. 34-37)

408. APPARATUS AND METHODS OF OCEANOGRAPHY. Harold Barnes. (Interscience Publish-, New York, 1959, Includes bibliographies.)

Contents include: Oceanography; Mariner biology; and Part I: Chemical.

RCL: QC11/B26a

409. MARINE GEOLOGY. H. Kuenen. (John Wiley & Sons, Inc., New York, 1950.)

Contents include: Geology, marine; Oceanography, physical; Marine geology.

RCL: GC57/K95m/R366 -- $9.50

410. THE EARTH BENEATH THE SEA. Francis Parker Shepard. (Johns Hopkins Press, 1959, Baltimore, 275 p., bibliography included)

Contents include: Submarine geology.
R&D Library: QE33/Sh4e

411. NEW PRODUCTS AND DEVELOPMENTS: (REMOTE) UNDERWATER VEHICLE. (Journal of the Society of Motion Picture and Television Engineers, Vol. 70, January 1961, p. 70)

A composite unit for underwater exploration consists of a 4-vidicon assembly; remote-controlled, steel-housed cameras; and enclosed mercury-vapor lamps capable of illuminating a distance of about 30 ft. The unit moves over the ocean floor, at depths down to 20,000 ft., at a speed of about 3 miles per hour. Signals from the cameras are relayed to a land-based monitoring and control station by means of a lightweight coaxial cable 5 miles long.

412. A LA RECHERCHE DU MONDE MARIN. Pierre De Latil and Jean Rivoire. (Librairie Plon, Paris, 1954, $2.04)

Contents include: Oceanography; Underwater Studies.

RCL: GC11/D37r/R1572

413. VASTNESS OF THE SEA: ADVENTURE IN THE MYSTERIOUS DEPTHS. Bernard Gorsky. Translated from the French by Alec Brown (Little, Brown, Boston, 1957, 1st American edition, 305 p.)

Contents include: Moana (Cutter); Marine fauna; Diving, Submarine; Ocean.

RCL: QH91/G68v

414. ALUMINAUT, DESIGN FOR THREE MILES DOWN: ALUMINUM SUBMARINE. (Machine Design, Vol. 32, 21 July 1960, pp. 24-25)

415. UNDERSEA RESEARCH. (News Item in Machine Design, 12 October 1961, p. 31)

Undersea research—to 6000 ft—can be carried out in the two-man Seapup VI designed by General Mills Inc., Minneapolis. The vehicle weighs only 12,600 lb, is less than 19 ft long and 8 ft wide. A mechanical arm performs tasks while the Seapup hovers or rests on skis on the ocean floor.

416. OCEANOGRAPHY AND MARINE BIOLOGY; A BOOK OF TECHNIQUES. Harold Barnes. (Macmillan, New York, 1959, 218 p., Bibliography: pp. 204-213.)

Contents include: Oceanography; Marine biology.

RCL GC57/B26o/R752

417. OCEANOGRAPHIC RESEARCH: $650 MILLION PROGRAM RECOMMENDED. RADM Charles D. Wheelock, U. S. Navy, retired. (Marine Engineering/Log, Vol. 65, No. 8, July 1960, pp. 53-57)

Current proposals for increases in ocean research activities would require 40 new vessels, cost $65 million annually, for next 10 years—four times the current rate of expenditure.

418. MV ACONA: FLOATING LABORATORY FOR OCEAN RESEARCH. (Marine Engineering/Log, Vol. 66, May 1961, p. 68)

419. "DRACONE" FLEXIBLE BARGES. H. W. Hall, Ministry of Supply, London, England. (Mechanical Engineering, July 1961, pp. 43-46, 6 refs.)

This nonrigid, ocean-going container for oil is called "Dracone" because of its similarity to a serpent (Greek-drakon). Forty-ton-capacity units have been built and are undergoing tests.

420. SEA LAUNCH: INDUSTRY VIEW. (Missiles and Rockets, News Item, 5 June 1961, p. 9)

Despite the indifference of NASA and the Air Force, rocket industry executives feel the country eventually will come around to using sea launch techniques for big booster -- both liquid and solid. Sea launch, they point out, could be a way of expediting the space program by bypassing the need for special handling and launch equipment. Some people think the only Air Force objection is that the Navy would be in on the scheme.

421. UNDERWATER "JEEP" ACQUIRED BY LORAL. (News Item from Missiles & Rockets, 28 August 1961, p. 21)

With the addition of Dr. Dimitri Rebikoff to its staff, Loral Electronics Corporation has acquired rights to the T-4—an underwater vehicle which is termed the "jeep of the deep." Fabricated of corrosion-proof, lightweight aluminum and equipped with a control system enabling it to dive, loop, climb, and roll under water, the craft is one 9 1/2 ft. long, less than a foot wide, and weighs only 180 lbs., fully equipped. The T-14, which operates at a constant speed of 3 knots for up to 2 hours at depths down to 230 ft., is designed for oceanographic research.

422. AEROJET IGNITES LIQUID SUSTAINER IN UNDERWATER TEST. (Missiles and Rockets, 28 August 1961, p. 28)

Using a water-filled, 25-ft. deep flame bucket, Aerojet-General engineers earlier this month successfully ignited a liquid-fueled Aerobee Junior sustainer in a captive test underwater. The umbilical connection was at the top of the rocket and out of the water at ignition. In the photo sequence here, the umbilical has dropped away a split-second after firing and the rocket is starting to rise. First the fins, then the whole rocket breaks clear of the water as it rises on 30-ft. shock cables. Aerojet said the test showed the feasibility of underwater launch of liquid-fueled rockets, which is contemplated under the Navy's Project HYDRA concept.

423. NEW OCEANOGRAPHIC SUB SCHEDULED. (News item from Missiles and Rockets, Vol. 9, No. 14, 2 October 1961, p. 9)

General Dynamics' Electric Boat Division will build Aluminaut, an oceanographic research submarine designed to operate at depths of 15,000 ft., for Reynolds International at a price of $2 million. Fifty feet long and with an operating range of 80 miles, it is the first sub ever to be built of aluminum. Launch date: 1963.

424. NAVY EXTENDS PERT TO GAUGE PROGRAM COSTS. (Missiles and Rockets, 15 January 1962, p. 16)

Polaris-proven computerized technique, in pilot-testing at GE and Lockheed, should avert some old misconceptions.

425. U. S. SEEKS OCEANOGRAPHY INSTRUMENTS. William Beller. (Missiles and Rockets, 28 August 1961, p. 22+)

Industry told it must turn out inexpensive, rugged and accurate devices to support expanding effort; Navy to buy $46 million worth.

426. SPAR HERALDS NEW ERA IN OCEANOGRAPHIC INSTRUMENTATION. William Beller. (Missiles and Rockets, 30 October 1961, pp. 22-23)

Navy's million-dollar tube will be used for unmanned acoustic research; more stable than submarine, 350-ft. vessel will operate with 86% of its length submerged.

427. SYSTEM YIELDS FINE SEA-FLOOR MAPS. William Beller. (Missiles and Rockets, Vol. 10, No. 4, 22 January 1962, pp. 24-25)

A recent advance in underwater photography may lead to large-scale "aerial" surveys of the sea bottom by ship-mounted or ship-towed cameras.

The new technique produces color stereoscopic pictures that are turned into topographical maps of micro-areas of the ocean floor.

These maps give remarkable delinations of the character of the floor, which become valuable data in a "sonar bounce" system used to detect submarines.

Oceanographers also see high value in it for tracing the flow of ocean currents, learning the geology of the ocean bottom, and studying the sea's organisms.

*ASW engineering.

428. 'THE TWINS'—MOST HOSPITABLE OF OUTER PLANETS? Robert L. Forward. (Missiles and Rockets, Vol. 10, No. 4, 22 January 1962, pp. 35-36+)

This is the third in a series of articles discussing the possibilities for probes and manned travel to the other planets of our solar system. Earlier articles covered Jupiter and Saturn.

The author, Robert L. Forward, is a Hughes Research Laboratories physicist pursuing advanced studies at the University of Maryland. He has published numerous papers.

The next article in the series will examine the problems involved in exploring Pulto.

*This ARTICLE discusses the use of the bathyscaphe.

429. WEIRD 'FLIP' VESSEL DESIGNED TO YIELD BREAKTHROUGHS. Bill Wilks. (Missiles and Rockets, 3 July 1961, pp. 38-39)

Research ship, longer than football field, will go to sea in horizontal position, switch to vertical to provide highly stable platform for submarine equipment.

430. NAVY USES UNDERWATER TV TO STUDY OCEAN BOTTOM. (Naval Research Reviews, November 1959, p. 30)

Underwater television equipment for deep-water surveys has been successfully employed by the Navy. The television system, built for the Navy's Bureau of Ships, was used recently in ocean-bottom surveys at depths of more than 600 feet. This is the first time that a continuous, remotely controlled, visual survey has been achieved at such depths.

Primarily designed for salvage and search operations, the vehicle is equipped with a closed-circuit television system, an underwater lighting system, and a movable camera-housing capable of training 70 degrees in any direction. The camera and its self-propelled unit are remotely controlled by means of a multi-conductor cable from a control vessel. The propulsion system enables the underwater vehicle to hover at any desired depth in currents and tides of several knots, assuring optimum use under varying conditions.

If fitted with suitable appendages, the vehicle could collect samples and specimens from the ocean floor and retrieve sunken objects.

431. ASPECTS OF DEEP-SEA RESEARCH, PROCEEDINGS OF THE SYMPOSIUM ON; HELD IN WASHINGTON, D.C., 29 FEBRUARY - 1 MARCH 1956. (National Academy of Sciences - National Research Council, Washington, D.C., 1957)

Contents include: Oceanography; Sea, Deep -- Research ; Oceans, Depths. Publication #473.; William S. von Arx, ed.

RCL: GC69/N 21a/ R1471. $1.75

432. OCEANOGRAPHY 1960-1970. (National Academy of Sciences, Washington, D. C., 1959)

Contents: I. Introduction and Summary of Recommendations. II. Basic Research in Oceanography During the Next Ten Years. III. Ocean Resources. V. Artificial Radioactivity in the Marine Environment. VI. New Research Ships. VII. Engineering Needs for Ocean Exploration. VIII. Education and Manpower. X. International Cooperation. XII. Marine Sciences in the United States--1958.

433. OCEANOGRAPHY 1960 TO 1970. 1--INTRODUCTION AND SUMMARY OF RECOMMENDATIONS. (National Academy of Sciences, National Research Council, Washington, D.C., 1959, 33 p.)

Contents: General Recommendations; Specific Recommendations; Education and Manpower; New Ships; Shore Facilities for Basic Research; Ocean-Wide Surveys; Engineering Needs; Radioactivity; Ocean Resources; International Cooperation; Budget and Operations; Membership of Panels.

434. OCEANOGRAPHY 1960 TO 1970. 2 -- BASIC RESEARCH IN OCEANOGRAPHY DURING THE NEXT TEN YEARS. (National Academy of Sciences, National Research Council, Washington, D. C., 1959, Chapter of a report in progress by the Committee on Oceanography, 21 p.)

Contents: Conditions Necessary for Basic Research in the Marine Sciences; Fields of Basic Research in Oceanography; History of the Oceans; The Ways of Life in the Sea; The Motions of the Waters; Ocean-Atmosphere Relationships; Estuaries and Coastal Waters; An Example of the Application of Basic Research -- Forecasting Oceanographic Parameters; The Financial Support for Basic Research.

435. OCEANOGRAPHY 1960 TO 1970. 4--OCEANOGRAPHIC RESEARCH FOR DEFENSE APPLICATIONS. (National Academy of Sciences, National Research Council, Washington, D. C., 1960, 15 p.)

Contents: Naval Oceanography During World War II; Navy Uses of Oceanographic Information: Design, Testing, Operational Use of Equipment, Forecasting; Support of Oceanographic Institutions; Support of Navy Laboratories and the Hydrographic Office; Systematic Observations and Collection of Data; Equipment, Devices, Manpower, and Funds; Future Prospects; Recommendations.

436. OCEANOGRAPHY 1960 TO 1970. 5--ARTIFICIAL RADIOACTIVITY IN THE MARINE ENVIRONMENT. (National Academy of Sciences, National Research Council, Washington, D. C., 1959, 31 p.)

Contents: Control and Monitoring; Research Needs; Coastal and Estuarine Environment; The Open Ocean; Sedimentation Processes; Effects of the Biosphere on the Distribution and Circulation of Radioisotopes in the Sea; Effects of Radiation Upon Marine Organisms; Field Experiments Utilizing Radioisotopes; Possible Effects of a Nuclear War on the Marine Environment.

437. OCEANOGRAPHY 1960 TO 1970. 7--ENGINEERING NEEDS FOR OCEAN EXPLORATION. (National Academy of Sciences, National Research Council, Washington, D. C., 1959, 22 p.)

Contents: Deep Manned Vehicles; Large Manned Buoys; Unmanned Buoys; Use of Aircraft in Oceanography; Other Specialized Research Vehicles; Development of New Instruments; Specialized Survey Instruments; High Seas Engineering; Major Laboratory Equipment.

438. OCEANOGRAPHY 1960 TO 1970. 12. - MARINE SCIENCES IN THE UNITED STATES-1958. (National Academy of Sciences, National Research Council, Washington, D. C., 1959, 8 p.)

Contents: Financial Support; Personnel Engaged in Oceanographic Work; Government Laboratories; Comparison of Laboratories; Growth of Oceanography.

439. OCEANOGRAPHY 1960 TO 1970. PART VII- ENGINEERING NEEDS FOR OCEAN EXPLORATION. (National Research Council, Report No. R-59-J-26E (Pt. 7), 1959, UNCLASSIFIED)

Contents include: Oceanography; Marine sciences; Bathyscaphs; Submarines, research; Engineering, marine; c.r. NAS R-59-J-26E (Pt. 7)

440. HYDRA PROGRAM. UNDERWATER EXPLOSION BUBBLE'S TIME HISTORY. M. Kaltwasser. (Naval Radiological Defense Laboratory, San Francisco, Report No. NRDL-TR-513, 2 June 1961, 21 p.) AD-260 391

A brief description of the physical phenomena - gas bubble, shock wave, and water flow - arising from an underwater spherical chemical detonation, along with a critique of past work on the subject is presented. Assuming a non-steady, irrotational, compressible, unbounded water flow in a zero gravitational field, and using appropriate fluid dynamic and certain assumed thermodynamic relations, the exact equation for the water potential function F is derived. The general solution, F(r, t) is discussed, and two particular solutions, with boundary conditions applied, are presented for the bubble radius a(t) up to the time of first maximum radius.

441. TRIESTE TO DEEPER WATERS OFF MARIANAS. (Naval Research Reviews, November 1959, p. 2)

The Navy will send its deep-sea diving sphere, TRIESTE (Research Reviews, April 1957), on a 3-month series of explorations off the Marianas Islands in early November, Pacific Fleet Headquarters has announced.

A team of civilian scientists and naval personnel from the Naval Electronics Laboratory, San Diego, will use the bathyscaph TRIESTE for tests to gather scientific data in waters deeper than those available near the continental shelf adjacent to the United States.

The tests will be conducted under the joint sponsorship of the Naval Electronics Laboratory and the Office of Naval Research. The explorations will be part of the global long-term oceanographic and marine research program pursued by the Navy. Headquarters for the project will be at the Naval Station on Guam.

The bathyscaph is capable of operating under its own power and of descending 20,000 feet. The craft designed and built by Aguste and Jacques Piccard, Swiss-born father-and-son team, and was delivered to the Navy in August 1958.

442. NATURAL RESOURCES OF THE SEA. Louis S. Kornicker, Office of Naval Research, Chicago, Illinois. (Naval Research Reviews, 1960, pp. 1-9)

The oceans cover about 71 percent of the earth's surface, yet in many respects we know less about this "inner space" than we do about outer space. Our ever-expanding economy and exploding world population lends an increasing urgency to the development of the oceans as a source of minerals, fuels, and protein foods. A brief look at the ocean reveals that it is truly a storehouse, for dissolved in a cubic mile of sea water is an average of 165,000 short tons of chemicals in the form of salts, besides the many thousands of species of plants and animals that live and die within its bounds. And the strata under the seas contain an estimated 40 percent of the world's total oil reserves. The commercial application of scientific results will eventually lead to development of the sea's natural resources so that they will provide maximum benefit to mankind. Toward this end, the Navy plays a large role in the development of the marine sciences in the United States.

443. UNDERWATER SOUND REFERENCE LABORATORY. John M. Taylor, Jr., Underwater Sound Reference Laboratory. (Naval Research Reviews, 1959, pp. 16-21)

Our Navy's modern sonar devices are vastly different from the crude apparatus first used to listen to underwater sounds. One of the earliest means of detecting unseen ships at sea was by listening through tubes fastened in a giant stethoscope-like arrangement to watertight blisters below the waterline on the hull of a ship. This early technique relied entirely on the sounds made by ships themselves as they moved through the water and on the sensitivity of the human ear to detect the sounds.

444. UNDER THE DEEP OCEANS; TWENTIETH CENTURY VOYAGES OF DISCOVERY. Thomas Frohock Gaskell, (Norton Publishing Co., New York, 1960, 239 p.)

Contents include: Ocean bottom; Deep-sea sounding; Challenger (Steamship)

RCL: GC57/G21u/R791

445. INTERNAL WAVES IN THE OPEN OCEAN. Masashi Yasui. Japan Meteorological Agency. (Oceanographical Magazine, Vol. 10, No. 2, December 1958, pp. 227-234, 14 refs.)

Besides intrinsic interest, studies of internal waves are also very important to formulate results of oceanographic observations. The author wishes to analyze and discuss the results of continuous observations taken in the upper 250 m layer of the Oyashio area, off the coast of Japan.

446. OCEANOGRAPHY IN NATO. Warren C. Thompson. (Office of Naval Research, London, Technical Report No. ONRL-49-61, 5 June 1961, 13 p.) AD-259 150

No automatic release to Foreign Nationals.

447. THE OCEAN. F.D. Ommanney. (Oxford University Press, Toronto, 1955.)

Contents include: Oceanography

RCL: GC57/Om5o/R796 - $1.40

448. PHYSICAL OCEANOGRAPHY. Albert Defant. (Pergamon Press, New York, 1961, Vol. I, 729 p., Vol. II, 598 p.)

Involves physical oceanography only, the scientific progress of which has been especially fast during the last fifty years owing to technical improvement of the working methods used on oceanographic research vessels and also to the extensive widening of our physical and chemical views about the phenomena occurring in the sea.

449. SURFACE WAKE OF SUBMERGED SPHERE. C. Eckart. (Physics of Fluids, Vol. 1, No. 6, November-December 1958, pp. 457-461)

Surface wake of submerged sphere moving in semi-infinite liquid with free surface is approximately same as that acused by traveling pressure disturbance in atmosphere above free surface; calculation of wake involves distinction between incoming and outgoing waves, introduced in Fourier transform of solution.

450. THE OCEANS, THEIR PHYSICS, CHEMISTRY, AND GENERAL BIOLOGY. H.U. Sverdrup, Martin W. Johnson and Richard H. Fleming. (Prentice-Hall, Inc., Englewood Cliffs, N.J., 1942, $20.00)

Contents include: Oceanography; Physics, Oceanographic; Chemistry, Oceanographic; Biology, Oceanographic; Marine Sciences.

A/N Library: 551.46/Sv2o/ B16994

451. MARINE PRODUCTS OF COMMERCE; THEIR ACQUISITION, HANDLING, BIOLOGICAL ASPECTS, AND THE SCIENCE AND TECHNOLOGY OF THEIR PREPARATION AND PRESERVATION. Donald K. Tressler and James McW. Lemon in collaboration with Alexander E. Alexander, and others. (Reinhold Publishing Company, Book Division, New York, 1951, 2nd edition, revised and enlarged. Includes bibliographies.)

RCL: SH335/T72m

452. THE ATMOSPHERE AND THE SEA IN MOTION. Bert Bolin. (The Rockefeller Institute Press, New York, 1959, $15.00.)

Contents include: Meteorology, Marine; Atmosphere - Studies; Oceanography.

RCL: QC994/B63a/R740

453. SOUS-MARIN. ENCYCLOPEDIE PRISMA DU MONDE. (Paris-16e, 26, Rue Desbordes-Valmore, Les Editions Prisma, 1957.)

Contents: Marine Life; Oceanography -- Encyclopedias.

RCL: GC9/Enle/R1576 -- $7.39

454. DEEP-SEA FREE INSTRUMENT VEHICLE. (Deep Sea Research, 1960, Vol. 7, pp. 61-67, Pergamon Press, Ltd., London, Printed in Great Britain) also (Scripps Institution of Oceanography Contributions, New Series, 1194, 1960, pp. 775-781)

A number of free instrument vehicles have been designed and tested. These are simple, reliable, inexpensive devices that transport recording instruments or sampling equipment to the deep-sea bottom, or to intermediate depth, and return them to the surface. Vehicles are provided with radar reflectors and other location devices. In the first tests the vehicles bore fish traps and were successfully operated to 2,000 fathoms.

Other instruments designed to make use of the free vehicles unique capabilities are under development.

455. NOMENCLATURE FOR TREATING THE MOTION OF A SUBMERGED BODY THROUGH A FLUID. (The Society of Naval Architects and Marine Engineers, New York, T. and R. Bulletin No. 1-5, April 1950, 15 p.)

Report of the American Towing Tank Conference prepared by the Hydromechanics Subcommittee of the Technical and Research Committee of the Society of Naval Architects and Marine Engineers.

456. EXPENDABLE SONOBUOY DESIGNED FOR LOW COST PRODUCTION. Victor de Biasi, assoc. ed. (Space/Aeronautics, March 1960, pp. 61-63)

Several thousand AN/SSQ-23 sonobuoys are being built for operational training and use. Fabrication and assembly costs were of paramount importance in the production design. Developed by the Hazeltine Corporation, Little Neck, New York, the AN/SSQ-23 is 36-1/8 in. long, 4-7/8 in. in diameter, and weighs close to 18 lb. It can be launched from aircraft flying at speeds up to 250 knots at 500 ft altitude. An auto-rotating blade head slows down and strightens out the descent, so that the sonobuoy hits the water at a 90-deg attitude within 9-11 seconds of release. A trigger plate at the bottom of the housing absorbs the shock of the water impact (up to 200 Gs), triggers the rotating-head jettison, and then drops free of the housing and sinks into the water, followed by the unwinding cable and hydrophone. A scuttling plug after one hour allows the buoy slowly to fill with water. The buoy then sinks, and the transmission frequency is kept open for new data.

457. DETECTION AND COMMUNICATIONS. J. Holahan. (Space/Aeronautics, Vol. 33, January 1960, pp. 58-63)

458. UNDERSEA WEAPON SYSTEMS. R.M. Loebelson and others. (Space/Aeronautics, Vol. 33, January 1960, pp. 39+)

459. U. S. NAVY UNDERWATER SOUND LABORATORY. Burton H. Andrews, USN. (Sperryscope, 1961, pp. 7-11)

At the U. S. Navy Underwater Sound Laboratory in New London, Connecticut, task forces of scientists, engineers, and technicians conduct a vital program of research and development in the area of undersea warfare. Now in its twentieth year, USL has provided the operating forces with an uniterrupted flow of highly successful electronic developments, each of which has made its mark on some phase of the Navy's tactical and strategic missions. In the area of submarine operations alone, it would be virtually impossible to point to a single major sonar system which did not have its origin at USL.

460. "UNDERSEA SATELLITES". (News Item from Undersea Technology, November/December 1961, p. 16)

A series of "underseas satellites" is scheduled to be strung between Hawaii and California next year in an effort to help explore the uncharted oceans. Walter Munk of the Scripps Oceanographic Institution hopes to launch the project with basketball-size "satellites", each containing a gauge to measure the tides, a seismometer, and a transmitter.

461. OCEANOGRAPHIC SYMPOSIUM. PART II. (Undersea Technology, Vol. 2, No. 6, November/December 1961, pp. 34-35)

During the two hectic days of the first Government-Industry Oceanographic symposium, there were 24 talks made before some 700 representatives of industry. Concerned entirely with instrumentation, they discussed the drastic need for instrumentation improvement. It would take several hundred pages to give descriptions and specifications of all the required instruments, but a coverage of some will give the general idea.

The U. S. Navy Hydrographic Office has compiled a list of instruments and systems required for three types of ships that perform oceanographic operations. These ships are: Survey Ships, Regional and Mobile Observational Ships (ASWEPS), and Ships-Of-Opportunity.

462. THE PRESSURE BARRIER: MARKETING OPPORTUNITIES STRESS R&D. Seabrook Hull. (Undersea Technology, Vol. 2, No. 2, May-June 1961, pp. 38-39)

Concurrently with their creeping assault on the depths, Navy Bureau of Ships, Office of Naval Research, and Bureau of Weapons are trying to leapfrog the pressure barrier—ideally with a submarine which will be as at home on the floor of the oceans' deepest trench as it is ducking back and forth through the thermocline. However, Navy will be happy if, within the proximate future, it can come up with a fleet of vessels with a maximum depth limitation of on the order of 10,000 feet. Some of the problems that must be solved before this goal can be realized are discussed in this article.

463. PORPOISE AIDS RESEARCH. I. Rehman. U.S. Naval Ordnance Test Station, China Lake, and University of Southern California, School of Medicine, Los Angeles, (Undersea Technology, Vol. 2, No. 6, November/December 1961, pp. 36-39, 9 refs.)

New concepts of speed and noise in underwater weapon development have caused the Navy to take a hard look at sea animal locomotion. The dolphin, for example, has been credited with speeds up to 25 and 30 knots by people on board fast moving ships. An analysis of torpedoes of the same size and estimated power shows that they would travel less than half this speed, indicating that the porpoise on an order of ten times more efficient. Less spectacular but more reliable is Professor Gray's (7) report of an average speed of 20 knots for porpoise. But even this figure indicates that the power or the drag of the animal deviates from the expected. That the porpoise has a remarkable performance is clearly indicated by feats such as these obtained at Marineland of the Pacific.

464. UNDERWATER REMOTE PROGRAMMING. George B. Schick and John D. Isaacs, Scripps Institution of Oceanography. (Undersea Technology, Vol. 2, No. 6, November/December 1961, pp. 29-32, 4 refs.)

Man's desire to penetrate the depths of the sea has led to development of many ingeneous devices to perform mechanical operations in that remote environment. As long as sampling and measuring gear were lowered into the sea on cables, reversal of thermometers and closing of nets and water samplers could be accomplished by a messenger-tripping system. The messenger "switch", however, essentially a single-channel pulse-type control system is quite limited as to the complexity of operations that it can perform. A messenger system capable of controling more than one instrument is cumbersome, and one capable of delivering two separate signals to more than one instrument becomes most complicated and unreliable. To perform more sophisticated operations in the sea, electrical hoisting cables were developed; but due to the many problems associated with electrical controls of instruments, electrical cables and the necessary winches are not yet in general use on oceanographic vessels.

465. OCEANIC TELEMETRY. James M. Snodgrass, Scripps Institute of Oceanography. (Undersea Technology, Vol. 2, No. 6, November/December 1961, pp 40-42)

Communication, in one form or another, is inextricably linked with oceanographic research. Unfortunately, it has only been recently that the oceanographer has become aware of his needs which involve world-wide requirements.

466. UNDERWATER NOISE CRITERIA THE MAN-MACHINE TEAM. Robert Taggart, Robert Taggart, Inc. (Undersea Technology, Vol. 2, No. 6, November/December 1961, pp. 26-28)

To establish a true goal for underwater listening it would be desirable that the radiated noise of a submarine be reduced far enough below the masking noise of sea-state zero so that it could not be heard at a reasonable distance. Similarly it would be desirable to have self-noise reduced to the point where the sonar operator could not hear it above the sea noise.

467. ASW, USW AND OCEANOGRAPHY ANALYSIS. (Underwater Engineering, Vol. 2, No. 1, January 1961, pp. 32-35)

The following short articles are included: '60 Systems Development Improved ASW Prowess; Hydrodynamic Research Was Fruitful in 1960; Sound Propagation Study Poses a 1961 Challenge; Hopes Held for Awareness of Undersea Potential; 1961 is Crucial Year for ASW Field Growth; A Prime UE Need is Accurate Instrumentation; Oceanography Stimulates Congressional Interest.

468. PRESSURE TESTING FACILITY PRODUCED INEXPENSIVELY FROM 16-INCH NAVAL SHELLS. Harold E. Edgerton, Massachusetts Institute of Technology, and Lloyd D. Hoadley, Woods Hole Oceanographic Institution. (Underwater Engineering, March/April 1961, pp. 29-30)

Underwater engineering is primarily a science. As an applied technology it is in its infancy. Few of the tools long taken for granted in the old technologies yet exist in oceanography and undersea technology. And those that do exist for detailed study of the oceans, environmental simulation, etc., are more often than not very costly. This article provides a valuable lesson in how to make do within the limits of available hardware and limited funds.

469. OCEANOGRAPHY CHALLENGE. E. E. Halmos, Jr. (Underwater Engineering, FIRST ISSUE, Vol. 1, No. 1, pp. 51-53)

Yes, the world's oceans are more than highways for commerce, more than hiding places for attacking or defending warships. They are also the source of enormous quantities of food, energy and materials that will become increasingly important as world populations increase, and Man continues to deplete the limited resources of his land areas.

At the moment, the United States seems to have at least a slight lead in this area--largely due to the efforts of the U. S. Navy and other government (and commercial) interests. But the Soviets are pulling up fast enough to have caused grave concern among those who realize the importance of such study.

470. UNDERWATER FIRE CONTROL. Seabrook Hull. (Underwater Engineering, Vol. 2, No. 2, March/April 1961, pp. 23-25)

Gear must be lighter, more compact and not preempt command decisions.

471. ALL-OUT OCEANOGRAPHY PROGRAM VITAL TO OUR SECURITY. INTERVIEW. Warren G. Magnuson. (Underwater Engineering, Vol. 1, No. 1, pp. 55-58)

The following questions are discussed: What is the basic reason for S. 2692, the Marine Sciences and Research Act? Marine scientists charge that we have a 25-year replacement program which must reach fulfillment in the next ten years. Do you think that time may run out on us? Government activity is directly linked to the national economy. What are the economic benefits to be reaped from a positive conclusion to your measure? Does S. 2692 create further proliferation among Federal agencies? Is the Office of Naval Research getting a sufficient share of the Navy dollar to do the comples oceanographic research required in this age of nuclear submarines and possible underwater warfare? Why, in your view, has the Soviet Union undertaken a crash program in oceanography?

472. VALUE OF SEISMIC RECORDINGS. George M. Pavey, Jr., Seismic Engineering Company, Dallas, Texas. (Underwater Engineering, Vol. 1, No. 1, pp. 31-33)

Underwater seismic explorations of tideland areas in many parts of the world are conducted from a single boat which carries all instrumentation necessary for detecting and recording seismic signals and for electronically surveying the area studied. All exploration is conducted while the ship is navigated on a steady course at a constant speed of several knots.

Depths from three to 100 fathoms are explored at distances up to 150 miles from shore. The ship carrying the gear is equipped to accommodate a crew for at least 10 days at sea.

473. REFERENCES ON THE PHYSICAL OCEANOGRAPHY OF THE WESTERN PACIFIC OCEAN. Hydrographic Office, Washington, D.C. (United States Government Printing Office, Washington, D.C., 1953.)

Contents include: Pacific Ocean, Oceanography; Oceanography, physical.

RCL: GC771/H99r/R639 -- $2.40

474. THE APPLICATION OF OCEANOGRAPHY TO SUBSURFACE WARFARE. (U.S.N.D.R.C.,* Div. 6, March 1951, UNCLASSIFIED)

Contents include: Oceanography; Acoustics, Underwater; Sound, Underwater -- Transmission; Water, Sea -- Studies; Submarines -- Diving.

*U.S. Naval Air Development Center

475. ARCTIC OCEANOGRAPHY BY SUBMARINES. E. C. LaFond, U. S. Navy Electronics Laboratory, San Diego, California. (U. S. Naval Institute Proceedings, Vol. 86, No. 9, September 1960, pp. 90-96)

The USS SKATE, surfaced in a polynya, carried the author as Chief-Scientist on her 1958 cruise to the North Pole. The work in arctic oceanography being conducted in nuclear-powered submarines of the U. S. Navy carries forward the dreams and plans of the late Sir Hubert Wilkins. With a World War I surplus submarine, renamed NAUTILUS, he reached a point only 300 miles from the Pole in 1931, operating on the surface.

476. OCEANOGRAPHY: THE NEED AND THE PROMISE. Everett S. Allen. Ass't. ed., Standard-Times, New Bedford, Massachusetts. (United States Naval Institute Proceedings, January 1961, Vol. 87, No. 1, pp. 76-83)

In all-out war, the sea's depths would be the most effective place to conceal both offensive and defensive action. In the Cold War, the potential of the ocean as a provider of fuel, minerals, and food may be a key factor in tipping the balance of world power. The author of this article is concerned, therefore, that Russia operates twice as many oceanographic ships and ten times as many Arctic research stations as does the United States.

477. WIND WAVES AT SEA BREAKERS AND SURF. Henry B. Bigelow and W.T. Edmondson. (U.S. Navy Hydrographic Office, Washington, D.C., 1947, $2.80.)

Contents include: Oceanography; Hydrography; and Waves, Ocean.

A/N Library: 551.46/B48w/B18433

478. PRACTICAL METHODS FOR OBSERVING AND FORECASTING OCEAN WAVES BY MEANS OF WAVE SPECTRA AND STATISTICS. Willard J. Pierson, Jr., Gerhard Neumann, and Richard W. James. (Department of the Navy Hydrographic Office, 1960, $3.80.)

A/N Library; 551.46/H99p/B18546

Contents include: Oceanography; Waves, Ocean; c.r. Navy Hydrographic Office; H.O. Pub. #603 (Report File)

479. OCEANIC OBSERVATIONS OF THE PACIFIC 1949. Norris W. Rakestraw, Paul L. Horrier, and Warren S. Wooster. (University of California Press, Los Angeles, 1957.)

Contents include: Oceanography; Pacific Ocean.

RCL: GC771/ R136/ R794 -- $4.50

480. OCEANOGRAPHY OF THE NORTH PACIFIC OCEAN, BERING SEA AND BERING STRAIT: A CONTRIBUTION TOWARD A BIBLIOGRAPHY. Mary C. Grier. (University of Washington, Seattle, Washington, 1941.)

Contents include: Oceanography; bibliographies.

RCL: QC781; G87o; Vol. II/ R730 -- $4.00

481. SOUND SCATTERING LAYERS AND THE VERTICAL DISTRIBUTION OF ZOOPLANKTON AND FISH IN THE SEA. K. V. Beklemishev. (Trans. of Uspekhi Sovremennoi Biologii, USSR, 1956, Vol. 41, No. 1, pp. 90-96) (Order from OTS or SLA, No. 61-28007, 1961, 23 p., 7 refs., HO Trans-109, $2.60)

The vertical diurnal migration of zooplankton is discussed in conjunction with the migration of predators following the plankton and the displacement of sound scattering layer conditioned by the migrations. The reasons bringing about the phenomena, such as light and temperature, as well as the frequencies of sound affected and modulated by the phenomena are brought into discussion so as to point out the significant trends in the concentrations and migrations of zooplankton.

482. EXPERIMENTAL STUDY OF SHIP MOTIONS. Wilbur Marks. (Woods Hole Oceanographic Institution, Massachusetts, Contract 1168(00), Technical Report, Reference No. 59-59, November 1959, 12 p., 16 refs.) AD-228 212

A linear theory of ship motion prediction was presented. An experimental verification of the theory was described for pitch and heave and in head and following seas. Improvements of certain coupling terms in the equations of motion are presented. The pitch and heave of the launch Risk (36-ft long) were recorded for a specific set of test conditions and analyzed in terms of the energy spectra of these motions. From the physical and geometrical properties of the vessel, the particular amplitude response operators in these degrees of freedom were computed with and without the assumption of coupling. The observed spectra were compared to the 2 computed sets of spectra. Results show that: (1) the linear prediction scheme agrees reasonably well with observation; and (2) the linear prediction scheme yields motion statistics which in general agree more nearly with observation.

483. AN EXPERIMENTAL STUDY OF SHIP MOTIONS. Wilbur Marks. (Woods Hole Oceanographic Institution, Mass., Contract Nonr-116800, Final Report, Ref. No. 60-30, July 1960, 11 refs.) AD-240 847

A linear theory of ship motion prediction was presented by St. Denis and Pierson in 1953 (Society of Naval Architects and Marine Engineers, Transactions, Vol. 61, 1953, pp. 280-357). This report describes an attempt at experimental verification of the theory, for pitch and heave, in head and following seas. Also considered are the improvements due to inclusion of certain coupling terms in the equations of motion as presented by Korvin-Kroukovsky (Ibid., Vol. 63, 1955, pp. 386-435). The pitch and heave of the Woods Hole Oceanographic Institution launch RISK (36 feet long) were recorded for a specific set of test conditions and analyzed in terms of the energy spectra of these motions. Also, from the physical and geometrical properties of the vessel, the particular amplitude response operators in these degrees of freedom were computed with and without the assumption of coupling and finally the corresponding two sets of motion spectra were computed. The observed spectra were compared to the two computed sets of spectra.

484. THE OCEAN FLOOR. Hans Pettersson. (Yale University Press, New Haven, 1954.)

Contents include: Ocean floor - Geology. Topography, submarine; Oceanography.

RCL: QC83/P450/R822 -- $3.75

485. U.S. PREPARES FOR NUCLEAR TIDAL WAVE WAR. -- Reveal Undersea Blast Could Wipe Out Coast Cities. George Carroll. Aviation Editor, The Hearst Newspapers, (Los Angeles Herald-Examiner, Monday, January 15, 1962, p. A-8.)

The United States has been quietly preparing for the possibility of a new type of nuclear warfare -- "water war" -- the creation of huge tidal waves by deep underwater ocean blasts.

Such blasts would generate tidal waves 70 feet high 100 miles away, wiping out the population of enemy coastal cities. Disclosure of the American preparedness measures can be made authoritatively today on the basis of unclassified but little-known Government reports. All but unnoticed for some time, the U.S. reports now loom in important perspective as the result of exclusive revelation in the Herald-Examiner that the Soviet Union is experimenting with underwater nuclear explosions.

SECTION E

UNINDEXED APPENDIX

(48 uncategorized
references)

1A. SYSTEM RELIABILITY: IMPORTANCE INCREASES WITH COMPLEXITY. E. J. Behney, General Dynamics Corp., Electric Boat Division. (Underwater Engineering, Vol. 2, No. 1, January 1961, pp. 23-24)

Unlike many other defense programs, there are no separate contracts for reliability achievements in the submarines building program, but the design and building contracts incorporate definite directions to accomplish reliability goals. The submarine building specification lists maximum reliability first under the principles of design and construction.

Reliability is enhanced by a further requirement, in many areas of the specification, that there must be an alternate mode of operation immediately available, to circumvent a single casualty.

2A. UNDERWATER RAMPETS MAY DRIVE SUBS FASTER. D. S. Hacker and P. Lieberman. (SAE Journal, Vol. 69, October 1961, pp. 74-75)

3A. SUBS MAY SWIM LIKE FISH. J. H. Harrison. (SAE Journal, Vol. 69, October 1961, pp. 88-90)

4A. SUBMARINE OF 1970. (Undersea Technology, Vol. 2, No. 5, September/October 1961, p. 15)

Should be able to hit over 100 knots at depths in excess of 4,000 feet and have much broader family of weapons.

5A. OCEANOGRAPHIC SYMPOSIUM. PART I. THE NEED FOR MARINE INSTRUMENTATION. Richard E. Munske. (Undersea Technology, Vol. 2, No. 5, September/October 1961, pp. 22-23)

This report is intended not to review the design and performance criteria of the needed instrumentation, but to point out that a grave situation does exist due of the lack of adequate instrumentation. The problem has become near-critical, and the security and welfare of this country could depend largely on the progress that must be made in the marine sciences.

6A. PUGET SOUND TO GET NUCLEAR SUB WORK? William L. Sturdevant, Jr. (Underwater Engineering,* Vol. 1, No. 1, 1960, pp. 49-53)

Lockheed Aircraft Corp., already diversifying into ASW and oceanography, may one day find itself in nuclear sub construction work through a recently-acquired subsidiary, informed sources in Washington believe.

The subsidiary, acquired in April 1959, is the Puget Sound Bridge & Dry Dock Co., Seattle. A Navy contract with Puget Sound would contribute to further industrial dispersal in this program.

Puget Sound has already built two destroyers for the Navy, and is converting two other Navy ships—one for underwater research work and the other for PROJECT HOPE.

* First Issue.

7A. A IS FOR ASROC. (Advertisement by Honeywell Military Products Group in Space/Aeronautics, April 1961, p. 220)

The Navy's newest antisubmarine missile, ASROC is recognized as one of the most lethal ASW weapons devised. It locates, tracks and destroys hostile undersea craft and is the nation's most deadly deterrent to nuclear type submarines.

ASROC, designed and developed by Minneapolis Honeywell's Ordnance Division, is a major contribution to the Missile field.

8A. WORLD'S BIGGEST 'INSTANT OCEAN'. William Beller. (Missiles and Rockets, 10 July 1961, pp. 28-29)

"Instant Ocean" is the latest in a series of major new hydrodynamic facilities developed in the wake of the nuclear submarine.

The U.S. Navy late last month dedicated what it calls "the largest simulated ocean in the world" at the David Taylor Model Basin in the Maryland suburbs of Washington, D. C.

The facility is designed to test exotic naval craft such as hydrofoils, hydroskimmers and ground-effect machines—as well as more conventional vessels. A similar "ocean" is already operating at the Netherlands Model Basin, and another is being completed at the Admiralty Experiment Works in England.

9A. WONDER MATERIAL FOR ASW IS PLASTICS...AND THE COMPANY FOR PLASTICS IS ZENITH. (Advertisement by Zenith Plastics Division, Gardena, California in Space/Aeronautics, March 1961, p. 190)

Plastics will not corrode. It will not undergo electrolysis. It is non-magnetic. It is more difficult to detect. And reinforced-plastics has an amazing strength, even at great depths.

Zenith has developed its own method of end-over-end filament winding, a process which gives a high strength-to-weight ratio. Zenith has equipment which makes it possible to mold reinforced plastics into huge and highly complex shapes. These are the reasons Zenith has the versatile capability to produce marine components "better" in plastics. This is why Zenith was the company called on to build the first all-plastics LCVP for the Navy.

10A. "BLOSSOMING" PARABOLIC ANTENNA FOR SPACECRAFT. OCEANOGRAPHY. (News Item from Space/Aeronautics, March 1961, p. 110)

Oceanography, which paces military and technological progress in undersea engineering, is costing us plenty. We're now spending $17.7 million a year to operate 16 research ships, which are studying the opacity of sea water to various wavelengths of light, heat, and other forms of energy; temperature and salinity at various depths and locations; vertical and horizontal temperature layering; currents; and contour mapping of the ocean floor. According to oceanographers, it costs roughly $5000 per day to operate a research vessel at sea.

Look for Congress to authorize—probably before the middle of the year—Project Tenoc, a 10-year program of extensive oceanographic research recommended by the National Academy of Sciences. This ambitious program will probably cost over $1 billion over the next decade.

11A. LASERS PUSHED FOR UNDERSEA DETECTION, RADAR AND SPACE COMMUNICATIONS. (News Item from Space/Aeronautics, April 1961, p. 118+)

Lasers, though they are still in the R&D stage, are being touted as just what we need in undersea detection, high resolution radar, and wide-band-width space communications. Hughes Aircraft has already built an optical radar around its ruby laser. The system, which operates on 6943 A, uses a transmitter consisting of a laser, a pulser, colimating optics and a shutter, and a receiver consisting of a collecting mirror, focusing optics, a spectral filter, a photomultiplier, an electronic amplifier, and a processing and display system.

The output of the laser is a beam about nine milliradians wide. It is collimated to about 0.33 milliradians. The shutter clips off the trailing edges of the pulses.

In clear-daylight tests, Hughes has gotten three miles in range; it believes this figure can be doubled with relatively minor improvements. Because of crystal heating, the system at present is pulsed once per second for a duration of three milliseconds. Peak power output is believed to be around 10 kw.

12A. BLUE-GREEN UNDERSEA LASER IS SAID TO REACH OUT 100 YD. (News Item from Space/Aeronautics, April 1961, p. 120)

Optical undersea detection is another possibility for the laser. It is well known that there is a marked dip in the wavelength-vs-attenuation curve for water in the visible part of the spectrum. This dep reaches a minimum in a 10-A-wide area in the green to yellow green. Here the attenuation is slightly more than 10^{-3} db/yd. Although the existence of this "hole" has been known for a long time, researchers has been prevented from exploiting it because of the lack of high-intensity sources at this wavelength.

Several firms are known to be studying the use of lasers as high-intensity sources for undersea detection. Trident, Cambridge, Mass., has a blue-green laser scheme in mind that, it believes, will reach out some 1000 yd in clear water.

13A. OPTICAL SYSTEMS MAY WORK ONLY IN FAIRLY CLEAR WATER. (News Item from Space/Aeronautics, April 1961, p. 120)

Pulsed lasers would not work underwater, Leavy claimed, because water acts like an unbounded cavity and random scatterers in it would set up a ringing effect that would mask out returned signals. Leavy also believes that optical system would work only in fairly clear water.

Trident has gained a good deal of experience in the optical-maser field over the last year. In addition to building a number of ruby lasers, it has a samarium laser and a ruanium-doped calcium fluroide laser under development. The company is exploring ways of making better crystals for lasers and is also working on exotic pump schemes. Its "undersea laser" would be a high power type that would generate about $10W/cm^2$ of CW power.

14A. PARACHUTE TO BE USED UNDERWATER FOR DATA. (Science News Letter, Vol. 78, 13 August 1960, p. 98)

The familiar parachute will take to the sea to aid oceanographers in observing ocean currents in a new project of the U. S. Coast and Geodetic Survey. The parachutes will be submerged in several areas about 50 miles offshore. Suspended at depths of approximately 16 and 1,000 feet, the big parachutes will be secured by line to surface floats and allowed to drift with the current. Careful tracking of the floats for a period of 48 hours will provide significant data on direction and speed of deep submarine currents.

15A. AROUND THE WORLD UNDER SEA. (U. S. News & World Report, 23 May 1960, pp. 104-105)

A U. S. submarine, the world's largest, has provided an answer to a question that has grown increasingly important in this missile era:

Can a nuclear-powered sub travel submerged halfway around the world, fire its missiles, return without surfacing?

The answer, just provided by the U. S. S. TRITON, is "Yes."

16A. CONSTRUCTION OF FIVE POLARIS SUBMARINES. (News Item from Underwater Engineering, Vol. 1, No. 2, 15 September 1960, p. 6)

Construction of five POLARIS submarines was authorized by Congress for fiscal year 1961. The 618, to be built by the Newport News Shipbuilding and Drydock Co., will be the last of the ETHAN ALLEN class submarines. The remaining three, the 617 to be built by Electric Boat and 619 nad 620 to be built at Mare Island and Portsmouth (N.H.) shipyards, respectively—will be of the LAFAYETTE class.

Announcement of construction plans for the 616 through 620 brings the Navy's POLARIS submarine count to two subs in commission (GEORGE WASHINGTON and PATRICK HENRY), seven under construction and five authorized for construction beginning this year, a total of 14 built, building or fully funded.

17A. QUIETEST SUB IN THE FLEET IS SAID TO BE THE NEWLY LAUNCHED SSK (N)-597. (News Item from Underwater Engineering, Vol. 1, No. 2, 15 September 1960, p. 12)

Quietest sub in the fleet is said to be the newly launched SSK (n)-597, TULLIBEE. Built by Electric Boat Division, the 273-ft long hunter-killer sub is the first tobe equipped with a turbo-electric drive. The sub also employs special gear to eliminate any possible sonar noises.

18A. PROPELLANTS FOR TORPEDOES. (News Item from Underwater Engineering, Vol. 1, No. 2, 15 September 1960, p. 12)

Propellants for torpedoes, accoring to Experiment, Inc., might involve use of free sea water as diluted oxidant with aluminum or zirconium fuels. In such a system, the performance of aluminum-sea water would be 114 hp-hr/cu ft (or 0.70 hp-hr/pound) which the zirconium analog would be 106 and 0.27, respectively.

19A. UNDERWATER JET ENGINE SYSTEMS. (News Item from Underwater Engineering, Vol. 1, No. 2, 15 September 1960, p. 12)

Underwater jet engine systems include the hydroduct (ramjet), hydropulse (pulsejet), hydroturbojet (turbojet) and both solid and liquid propellant rockets. Aerojet-General concludes that rocket systems offer the greatest speeds (at reduced ranges) than those systems using rotating machinery.

20A. HERE'S THE ASW MARKET. (Underwater Engineering, Vol. 1, No. 2, 15 September 1960, pp. 18-21)

The underwater engineering market is an expanding market. Consider these facts:

The minimum anti-submarine warfare (ASW) portion of the Navy's budget for Fiscal Year 1961 totals $1.42 billion. This excludes the costs of military personnel and operations and maintenance, and does not take into consideration that practically all ships and aircraft are concerned with ASW.

There is a never-ending search for improvement in underwater engineering capabilities. The Navy is the first to recognize that its over-all ASW capabilities are still far from satisfactory.

There is not a single piece of the Navy's ASW equipment which cannot be improved. This is a challenge to American industry.

21A. FIRST NAVY SHIP TO GET A MINIATURIZED AUTOMATIC DEGAUSSING SYSTEM. (News Item from Underwater Engineering, Vol. 1, No. 2, 15 September 1960, p. 22)

First Navy ship to get a miniaturized automatic degaussing system is the WAHOO. The new system was installed while the WAHOO underwent overhaul at Pearl Harbor.

The degaussing system will neutralize the submarine's magnetic field, making the ship operational in mined areas. To accomplish this, a rigid copper cable was wound around and into the pressure hull at predetermined locations vertically and horizontally. The cable was connected in proper polarity and energized to neutralize the magnetic field created by the ship. The Navy will make a thorough evaluation of the degaussing system before installing it on other submarines.

22A. RUSSIA'S ASSETS IN THE 'WET WAR'. William O. Foss. (Underwater Engineering, Vol. 1, No. 2, 15 September 1960, pp. 25-28)

As a nation, whose history has always been based on terra firma, Russia has progressed rapidly when it comes to winning the struggle of the oceans.

Ten years ago the Soviet Navy ranked about ninth among the world navies. Today the Soviet Navy ranks No. 2 to the U. S. Navy.

Her submarine force is the biggest in the world.

Soviet oceanography was in a provincial state about ten years ago. Today the Soviet oceanographic research program far surpasses that of the Free World.

23A. COMPUTING HAZARDS OF NUCLEAR ATTACK. H. Burke Horton, Remington Rand Univac. (Underwater Engineering, Vol. 1, No.2, 15 September 1960, pp. 32-34)

This article will not be a discussion of results, findings, or recommendations concerning American vulnerability. Much of such information is highly classified. What is presented here is an unclassified discussion of the techniques which permit analysis of the vulnerability of the United States to nuclear attack. The methods used are of interest to computer users because they illustrate a method of attack on the increasingly important class of problems in which direct experimentation is either impossible or not permissible.

24A. TRANSDUCERS: KEY TO SONAR. George Rand and John Devine, Sperry-Rand Corporation, Surface Armament Division, Sperry Gyroscope Co., Great Nect, Long Island, New York. (Underwater Engineering, Vol. 1, No. 2, 15 September 1960, pp. 35-37)

Effective detection of submerged objects, a vital consideration in submarine weapons systems design, hinges upon proper use of translation devices for the conversion of acoustic and electrical energy.

25A. TORPEDOES AND UNDERWATER ROCKETS. Barron Kemp. (Underwater Engineering, Vol. 1, No. 2, 15 September 1960, p. 40+)

Here's a close look at tomorrow's weapons--and some basic considerations.

26A. TORPEDO BRIEFS. (Underwater Engineering, Vol. 1, No. 2, 15 September 1960, pp. 56-59)

This illustrated article describes the SOLARIS Robot and its control systems. Various types of ASW devices are also described.

27A. TOMORROW'S TORPEDO: FASTER, QUIETER, AND MORE SOPHISTICATED. (Underwater Engineering, Vol. 1, No. 2, 15 September 1960, pp. 60-63)

The torpedo has accounted for more enemy tonnage than any other weapon.

But the big problem today is the enemy submarine; and nearly everybody agrees that tomorrow's anti-submarine torpedo must be 1) faster, 2) quieter, 3) capable of greater range and search, and 4) idiot-proof.

POLARIS submariners are now receiving closed circuit TV factory training on the operation and maintenance of POLARIS fire control and inertial guidance at General Electric's Ordnance Dept. in Pittsfield, Massachusetts. Instructor R. E. Creamer, Jr. conducts a class while in another part the the plant G. W. Haihl keeps the TV camera on the lesson's subject.

28A. ASW. AN EXTENSIVE LAND-AIR-SEA OPERATION. (News Item from Undersea Technology, Vol. 2, No. 4, July/August 1961, p. 12)

An extensive land-air-sea operation to determine the reliability of electronic devices used in the Navy's vital ASW defense program is being jointly undertaken by Brunswick Naval Air Station and Vocaline Company of America, Inc. Vocaline has implemented and is operating a complete electronic test facility consisting of monitoring station, laboratory and a 64-foot diesel-powered vessel provided by the Navy.

29A. NEW TECHNOLOGIES. THE FIRST KNOWN UNDERWATER ANALYSIS. (News Item from Undersea Technology, Vol. 2, No. 4, July/August 1961, p. 12)

The first known underwater analysis of the ocean's radioactive sources have been made by the Navy Ordnance Lab with a new ultra-sensitive radiation measuring device called DUNC—Deep Underwater Nuclear Counting—sensitive enough to detect one atom of radium in a billion billion molecules of water!

30A. POLARIS...TODAY AND TOMORROW. Richard E. Munske. (Undersea Technology, Vol. 2, No. 4, July/August 1961, p. 20)

Most important to the submarine is survival. Design considerations are established around the concept that the submarine must avoid detection, no less identification. Of course, as science progresses with time, enemy active and passive sonar -- and possibly other techniques -- will likewise improve, leaving POLARIS faced with greater susceptibility to detection. But, through intuitive foresight coupled with the technological efforts of industry, POLARIS seems to be in a pretty good position to maintain its high degree of immunity with counter-measures and improved undersea performance.

31A. FILAMENT WOULD SUBS. (Advertisement by Zenith Plastics in Undersea Technology, Vol. 2, No. 4, July/August 1961, p. 30)

Zenith Plastics Division of 3M Co. has made available a small brochure on structural filament would submarines. Included is a paper on "Reinforced Plastics for Hydrospace Vehicles."

32A. EVALUATION OF ASW EQUIPMENT. Thomas D. McGrath, U. S. Navy, Key West Test and Evaluation Detachment. (Underwater Engineering, Vol. 2, No. 1, January 1961, pp. 46-48)

The cycle from inception to operational hardware of new equipments is initiated in the Office of the Chief of Naval Operations, where requirements are established and developmental responsibilities assigned. Such requirements may result from a recognized need, from fleet proposals, from studies, or proposals from technical agnecies.

33A. RESEARCH SHIPS DOCK AT FRONT DOOR: SDL* SEEKS UNDERSEA ANSWERS. (Underwater Engineering, Vol. 2, No. 1, January 1961, pp. 42-44)

Honeywell's lake Washington lab sends its ships to nearby deep water for testing of ASW and USW equipment, and to investigate special problems in oceanography.

* Seattle Development Lab.

34A. OCEANOGRAPHY STIMULATES CONGRESSIONAL INTEREST. Edward Wenk, Jr., Library of Congress. (Underwater Engineering, Vol. 2, No. 1, January 1961, pp. 34-35)

National leaders of both political parties have noted the emerging significance of science and technology as an essential ingredient of our national security, and oceanography has been identified as one of the fields currently warranting attention. In light of the arguments for expanding the national program in the ocean sciences, coupled with a widely prevailing sense of urgency, the topic has received unprecedented attention from both the executive and legislative branches. Eight different bills were placed before the 86th Congress, according to their preambles, with the intent of assuring an enhanced posture in oceanography by the formulation of a unified program by adequacy of funding, and by the establishment of a statutory base for coordination of the various Federal agencies concerned.

35A. PRIME UE NEED IS ACCURATE INSTRUMENTATION. T. R. Thoren, Borg-Warner Corporation, Pesco Products Division. (Underwater Engineering, Vol. 2, No. 1, January 1961, p. 34)

Accurate instrumentation is one of the prime requirements for scientific exploration in any field. Electrically-powered instruments provide many advantages in undersea observations and measurements because they combine the merits of accuracy, recording, storage of data, and the possibility of unattended operation for long periods of time. The duration of unattended time depends, of course, directly on the life of the electric power source. It is desirable that the unattended life shall be in many months, and in some instances, years. This requirement imposes a severe handicap on conventional sources of electric energy such as isolated batteries and the various forms of generators that employ chemical fuels.

36A. SOUND PROPAGATION STUDY POSES A 1961 CHALLENGE. Winston E. Kock, Bendix Corporation, Research Laboratories Division. (Underwater Engineering, Vol. 2, No. 1, January 1961, p. 33)

There is much that is still not known about the way sound propagates in the sea over great distances. The designer of future long-range sonar equipment is in urgent need of answers to such questions as to how well sonar signals are preserved in amplitude, frequency, and phase after traversing paths which are many miles long.

37A. THIRD GENERATION OF POLARIS SUBMARINES. (News Item from Underwater Engineering, Vol. 1, No. 2, 15 September 1960, p. 6)

The third generation of POLARIS submarines will bear an illustrious name. The lead ship of the new class will be named LAFAYETTE, in honor of the French marquis who became a hero in the American Revolution.

The LAFAYETTE, designated SSBN 616, will be built by the Electric Boat Division of the General Dynamics Corporation, at Groton, Connecticut. Displacing about 7,000 tons; the LAFAYETTE class submarines will be 425 ft long.

The first series of POLARIS submarines, with the GEORGE WASINGTON (SSBN 598) as lead ship, displace about 5,400 tons each and are 380 ft long. A second family of these subs, the ETHAN ALLEN (SSBN 608) class, have an overall length of 410 ft and displace 6,900 tons.

38A. PCH IS THE DESIGNATION FOR NAVY'S SUB CHASER, HYDROFOIL. (News Item from Underwater Engineering, Vol. 2, No. 2, 15 September 1960, p. 12)

This craft, which is to have a speed greater than conventional ASW ships, will be 115 ft long, displace 110 tons, and will have a 32-ft beam. It will have a long flying range and an even longer cruising range, will be equipped with the latest sonar, and heavily armed with anti-submarine weapons.

39A. HYDRODYNAMIC RESEARCH WITH A PORPOISE. (Naval Research Reviews, March 1961, pp. 11-13)

If present theories on the porpoise's secret of speed are correct, future subs and torpedoes may have heated skins that can ripple. For it is known that the porpoise is capable of swimming efficiently at great speeds with little drag or disturbance, of transmitting and receiving sounds over a distance of several miles, and of withstanding deep ocean pressures beyond the physiological capabilities of other mammals. And the porpoise does all these things better than anything yet devised by man. Navy scientists studying these phenomena say the answers could change their concepts of torpedo design, underwater sound detection, and anti-submarine warfare.

40A. THE ALUMINAUT. (Naval Research Reviews, January 1960, pp. 18-21)

In the not-too-distant future, American oceanographers will be exploring the ocean floor in an aluminum research-type submarine, appropriately named "Aluminaut." In both purpose and concept it will be similar to the Piccard "Trieste," but it will be far roomier (because the observers will be inside the hull, rather than in a ball-like gondola) and will have much greater underwater cruising radius: nearly 100 miles as opposed to Trieste's 1/4 mile. The submersible will be able to dive 15,000 feet, which is equal to or greater than the known depth of 60 percent of the world's oceans.

41A. NATO ASW CENTER ESTABLISHED IN ITALY. (Naval Research Reviews, June 1959, p. 5)

An international research laboratory whose aim is to study and help solve basic problems in antisubmarine warfare has been established at the Italian naval base at La Spezia, midway between Genoa and Leghorn. It will be known as the SACLANT ASW Research Center. "SACLANT" stands for Supreme Allied Commander Atlantic.

The ASW Research Center will monitor and analyze oceanographic measurements in selected waters. Among other chief functions will be operational research and analysis plus limited development in various phases of antisubmarine warfare. Present ASW scientific knowledge of the nine nations will be pooled in the Center, and findings of new studies funneled back to the participants. All NATO nations with ASW potential also will have free access to the findings.

42A. NEW RUBBER PAINT SPEEDS SUBMARINES. (Science News Letter, 30 January 1960, p. 71)

A rubber paint has been developed that will give submarines a more-yielding "skin" and may enable ordinary submarines to slip through the water at speeds approaching 70 miles an hour.

43A. RESEARCH NOTES. NEW TOOL FOR DEFENSE AND RESEARCH. (Naval Research Reviews, September 1961, pp. 24-25)

The U. S. Navy Mine Defense Laboratory in Panama City, Florida, has recently developed an interesting new oceanographic device. Although not yet on the production lines, this instrument may soon join a growing family of simple and reliable oceanographic tools that may enable every Naval vessel to gather valuable scientific data.

44A. ATTACK SUBMARINE. (News Item from Underwater Engineering, Vol. 1, No. 2, 15 September 1960, p. 6)

The attack submarine SCAMP becomes the Navy's 21st nuclear powered submarine when she slides down the ways October 8 at the Mare Island Naval Shipyard. She is the fourth atomic sub to be built at Mare Island.

45A. SPEED OF SOUND MEASUREMENT. F. J. Suellentrop, A. E. Brown, and Eric Rule, Lockheed Missiles and Space Division, Palo Alto, California. (Undersea Technology, Vol. 2, No. 5, September/October 1961, p. 32, 8 refs.)

The need for a simple and direct method of measuring speed of sound in the ocean has recently been stressed in the literature. At present, the speed of sound is usually derived indirectly by considering the speed to be a function of the temperature, pressure, and salinity in the ocean. Knowing or measuring the values of these parameters, speed of sound is determined using any one of a number of empirically-derived formulae which contain up to six hours. This process involves considerable computation, and controversy exists as to which formula is most suitable.

46A. THE OCEANS. (Undersea Technology, Vol. 2, No. 5, September/October 1961, p. 16+)

First of a series, this article is a general rundown on the world ocean; will be followed by a series detailing the many aspects of this environment.

47A. '60 SYSTEMS DEVELOPMENT IMPROVED ASW PROWESS. Alton D. Anderson, Cook Technological Center, Cook Research Laboratories. (Underwater Engineering, Vol. 2, No. 1, January 1961, p. 32)

Sparked by the organization of BUWEPS for management and direction of weapon system programs, new weapon system developments advanced fleet ASW effectiveness in 1960. Considering the minimal expenditures in ASW weapon system research and development, the progress made in 1960 is remarkable.

48A. OCEANOGRAPHY ABOARD THE TRITON. M. Smalet, N. Mabry, and G. Wilkes, U. S. Navy Hydrographic Office, Washington, D. C. (Naval Research Reviews, September 1961, pp. 1-7)

In February 1960, the Hydrographic Office was presented with a unique opportunity for a trio of scientists to conduct coordinated research in geophysics and ocenography. The Commander of the nuclear submarine TRITON, had chosen, as a shakedown cruise, to make an epochal circumnavigation of the globe while submerged. Inasmuch as this circumnavigation would provide the means of obtaining continuous data profiles through many relatively untraveled and unknown areas, the Hydrographic Office hastened to install on board equipment for oceanographic, bathymetric, and geophysical surveys.

The historic voyage of the TRITON was more than a unique shakedown cruise. It proved that a nuclear submarine is indeed an admirable ship type for scientific studies of the seas.

AUTHOR INDEX

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